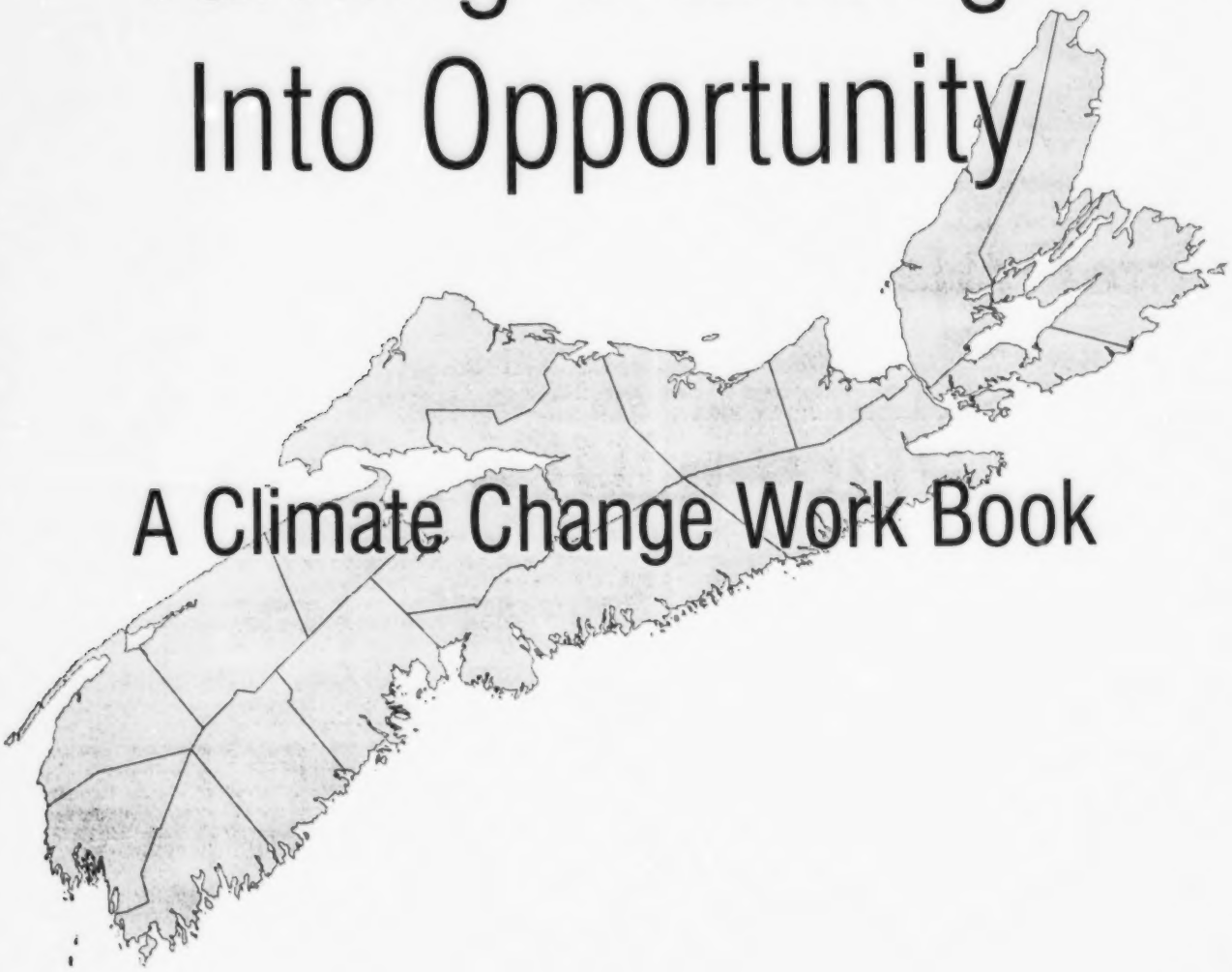
Turning Challenge Into Opportunity



A Climate Change Work Book

VOLUNTARY PLANNING

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1. Introduction

1.1 A Nova Scotia Climate Change Strategy

Global climate change is an important issue for our environment and for our economy. It has the potential to affect all Nova Scotians, at home, at work and at play.

Changes in temperature, precipitation, wind patterns, and other elements of the climate are expected to occur at a faster rate in the next 100 years than at any other time during the past 10,000 years. Many scientists have concluded that some degree of human-induced climate change is inevitable and may already be happening.

Countries around the world have indicated their intention to reduce their greenhouse gas (sometimes referred to as GHG) emissions as part of an international agreement on climate change called the Kyoto Protocol. Our main trading partners such as the United States, Japan, and the European Union, have started to act to reduce emissions of carbon dioxide, methane and other greenhouse gases that contribute to climate change.

> **"The balance of evidence, from changes in global mean surface air temperature and from changes in geographical, seasonal and vertical patterns of atmospheric temperature suggests a discernible human influence on global climate."**
>
> *Intergovernmental Panel on Climate Change, Second Assessment Report.* 1995

Here in Canada, all provinces and territories are participating with the federal government in a national effort to look at Canada's options for reducing greenhouse gas emissions, examining their costs and benefits. Individual provinces and territories are working on climate change strategies and actions.

Canada accounts for about two per cent of the world's total greenhouse gas emissions, but we represent only 0.5 per cent of the world's population. Our per capita emissions are second only to that of the United States.

Nova Scotia ranks sixth among provinces and territories for its emissions of carbon dioxide (one of the main greenhouse gases), with approximately 3.5 per cent of Canadian emissions. The province, however, has the third highest per capita greenhouse gas emissions in Canada.

In Canada, about 80 per cent of greenhouse gas emissions come from burning fossil fuels. In Nova Scotia, the figure is closer to 90 per cent. Fossil fuel has always been important to Nova Scotia's economy. From our historic coal industry to our new natural gas industry, Nova Scotia has profited from the development and use of fossil fuels.

Source of GHG Emissions, Nova Scotia – 1996

Carbon Dioxide	85.6%
Methane	10.3%
Nitrous Oxide	4.0%
PFCs, CFCs, SF6	0.1%
Combustion Total	87.6%

Nova Scotians need to assess the economic, social and environmental costs of climate change. We need to better understand what courses of action are open to us, and what strategies will work for us.

Why prepare a Nova Scotia strategy at this time? Climate change science is now much clearer in estimating human effects on climate change and forecasting probable impacts. Earlier this decade Nova Scotians participated in the preparation of a Climate Change Strategy and the Clean Air Task Force report. A number of recommendations from this work have been incrementally put into effect. Attention is now heightened on climate change issues because of international recognition and acceptance that a concerted effort is needed to lower GHG emissions, thereby lowering perceived risks.

It is incumbent upon Nova Scotia to revisit the issue of climate change in light of Canada's commitment to lower GHG emissions. Nova Scotia is participating with the federal government and other provinces and territories in developing a National Climate Change Strategy for Canada. Nova Scotia will be asked to take part in a national effort to reduce GHG emissions. .We want to be an active participant in this process to guard against having actions and solutions imposed on us by other jurisdictions. Our strategy will be made in Nova Scotia and will build on our earlier work. Most of all, we want to know how you think we should respond to this challenge.

Nova Scotians can respond to climate change in two ways: mitigation and adaptation. Mitigation deals with reducing greenhouse gas emissions. Adaptations will be required, as well, to deal with the impacts of climate change. How effective we are globally in mitigating will determine the rate of climate change. This, in turn will determine how quickly and to what extend we will have to adapt to climate change. Mitigation and adaptation are therefore inevitably linked. Some degree of adaptation will be necessary regardless of how effective we are in reducing emissions.

On one hand, action to significantly reduce emissions will require some fundamental changes in our economy and in the way we live, work and travel. On the other hand, not acting quickly enough is expected to lead to changes that can be just as fundamental, yet difficult to predict or control once they have taken or are taking place. Such changes could include loss of the use of farmland, flooding in coastal and low-lying areas, collapse of certain fisheries, and other impacts related to changes in our climate.

Finally, there are economic opportunities for Nova Scotia businesses in meeting the climate challenge of climate change, both within Nova Scotia and outside of the province. Opportunities

can range from retrofitting existing buildings to developing alternatives to activities that cause emissions today.

The goal of this workbook is to provide background information on climate change and stimulate debate on a climate change strategy for Nova Scotia. Addressing the issue of climate change in an effective and fair manner will require everyone's involvement and expertise.

1.2 Workshops and Workbook

Voluntary Planning is an organization set up by the provincial government to involve individuals, institutions and business around the province in shaping the future of our province. We have been asked by the Province of Nova Scotia to seek your views on climate change and to report back to government. In November 1999, Voluntary Planning is therefore organizing public workshops in Amherst, Halifax, New Glasgow, Sydney, Bridgewater, and Yarmouth.

The goal of the workshops is to seek the views of Nova Scotians in preparation for a provincial climate change strategy. We want your views on the principles on which a Nova Scotia strategy should be based, what the priorities should be, and how we should measure success. The resulting strategy will set a broad framework for action. A full action plan will follow.

This workbook is intended to stimulate discussion. It provides some basic facts about climate change, including the science, the national and international settings, and the economic linkages. The workbook outlines the science of climate change in Section 2, and describes its potential impacts on Nova Scotia in Section 3. This section includes a discussion of the impacts of climate change on Nova Scotia's economic sectors, and whether or not these sectors are significant greenhouse gas producers. Section 4 then begins the discussion on principles to guide the provincial strategy on climate change. Questions are included in this part to facilitate the discussion.

In Section 5, the contributions of various sectors to greenhouse gas emissions and examples of their efforts to reduce these emissions are described. The focus is on economic sectors that contribute most to the emission of greenhouse gases, and examines how the most meaningful reductions in emissions can be achieved. Each of the sectoral discussions is followed by questions. These questions are meant to stimulate public debate on the approach Nova Scotia may wish to take to reduce greenhouse gas emissions, and limit the impacts of climate change.

A three-person panel chosen from members of Voluntary Planning and Clean Nova Scotia will lead the workshops. Following review by participants in the workshops, the workshop panel will prepare a final report on the consultation process by early January 2000. The Department of Natural Resources and the Interdepartmental Committee on Climate Change, using information gathered during the consultation process will then draft a strategy. If you are not able to attend the workshops, or wish to submit comments after the workshops have been held, you may do so by forwarding your comments to the Climate Change Working Group, Voluntary Planning, Suite

600, 1690 Hollis St., Halifax B3J 3J9, Tel: 902-424-8644, e-mail: Fraserri@gov.ns.ca. We ask you to submit your response by Friday, December 3, 1999, so that they can be included in the report and considered in the strategy-drafting process. An electronic version of the workbook is available at www.gov.ns.ca/natr.

1.3 The International Context

In June 1992, Canada signed the *United Nations Framework Convention on Climate Change* (UNFCCC) and agreed to work toward reducing its greenhouse gas emissions back to the level of emissions in the year 1990 by the year 2000. This international convention came into effect on March 21, 1994, and now has 179 member countries. Almost none of the signature countries, including Canada, will meet the goal of stabilizing their emissions to 1990 levels by the year 2000.

At the end of 1997, countries that signed the UNFCCC met in Japan and have since signed the *Kyoto Protocol*, in which approximately 40 developed countries agreed to reduce their greenhouse gas emissions to an average of about five per cent below their 1990 levels by 2008 to 2012. Canada's target is six per cent below. (The USA committed to a seven per cent reduction and the European Union accepted an eight per cent reduction.)

Nova Scotia's Emissions Profile

Year	Emissions (Million Tonnes CO_2
1990	19.4
1995	19.4
2010 (forecast)*	21.2
-6% target	17.7
Required Reduction	3.5 (16.5% BAU)

Developing countries have not yet adopted an emission reduction target under the *Kyoto Protocol*. Canada and other developed nations are working with developing countries to help them in reducing greenhouse gas emissions, with the goal of accepting targets in the future. This is crucial because if developing countries increase their per capita emission to those of developed countries, GHG emissions will increase dramatically.

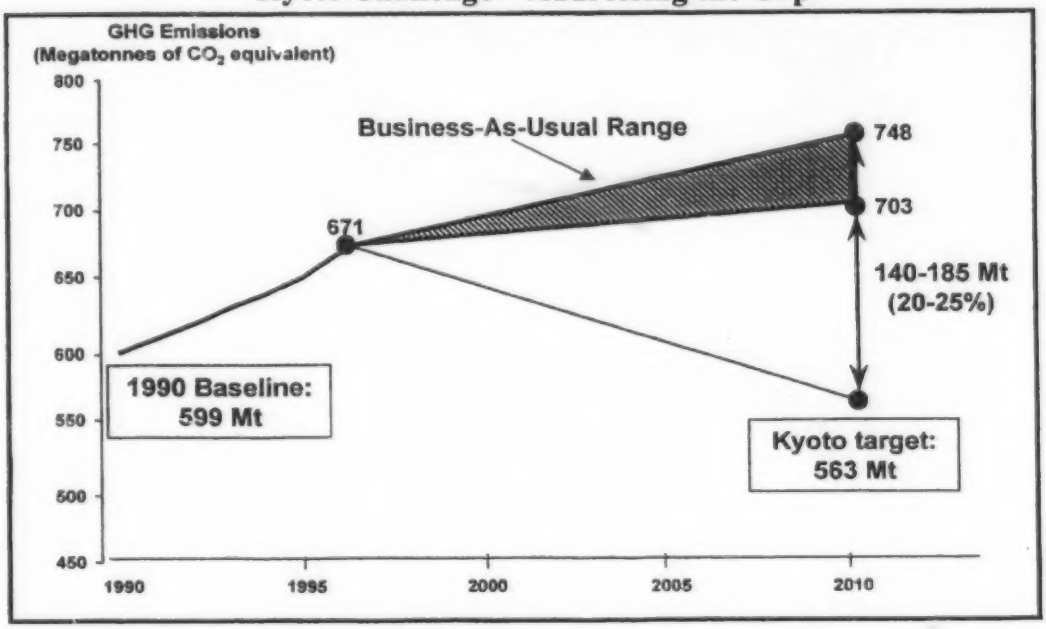
Country	Population (Millions)	Energy Use	
		Per Capita (10^9 Joules)	National (10^{18} Joules)
Canada	28.5	324	9.23
China	1238	23	28.5
India	931	9	8.37

The *Kyoto Protocol* includes various options for countries to meet their greenhouse gas emission reduction targets. They include the following mechanisms to allow countries to meet their obligations even if domestic emissions are still higher than the target:

- Countries can fund projects that reduce emissions in other developed countries.
- They can fund projects that reduce emissions in developing countries.
- Developed countries may purchase reduction credits from countries that exceed their own reduction targets. In other words, a country that does better than required gets credit for this and can sell those credits to countries that have not met their targets domestically.

There is considerable uncertainty about how these "flexibility mechanisms" will work. Negotiating the rules and regulations has proven difficult. This uncertainty has made it more difficult for Canada and other countries to determine the cost of meeting the *Kyoto Protocol*.

Kyoto Challenge – Addressing the Gap



1.4 Canada's National Climate Change Process (NCCP)

Meeting in December 1997, Canada's Prime Minister and premiers agreed to work cooperatively to assess the impacts that meeting the Kyoto target would have on Canada. They asked energy and environment ministers of the federal government, provinces and territories to assess the options, costs and benefits for Canada of a six per cent reduction from 1990 levels in greenhouse gas emissions for the period of 2008 to 2012.

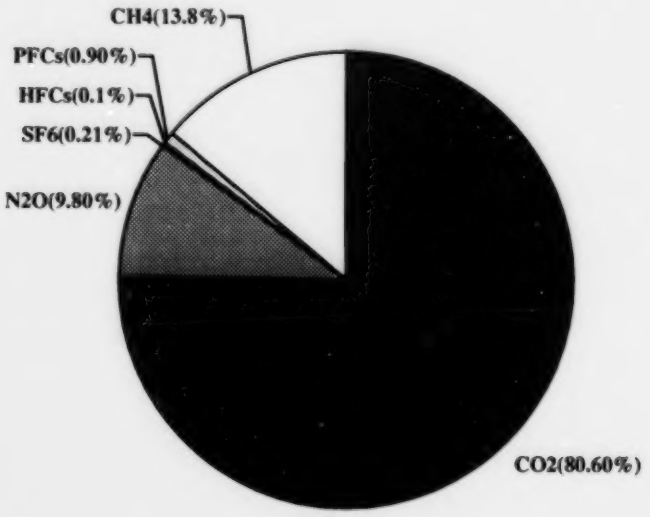
First Ministers set out the following basic principles to guide climate change work in Canada:

- Canada must do its part.
- Costs and options for reducing emissions must be known.
- All Canadians must participate.
- No region or sector shall bear an unreasonable burden.

A National Climate Change Process with its own Secretariat has been created to develop a National Implementation Strategy for Canada. As part of this work, 16 Issue Tables were established to develop and analyze options for emission reductions. The Issue Tables include experts from government, industry, and environmental non-governmental organizations. Tables address the following topics: "agriculture and agri-food", "analysis and modeling", "buildings", "credit for early action", "electricity", "enhanced voluntary action", "forests ", "industry", "Kyoto mechanisms", "municipalities", "public education and outreach", "sinks (carbon sequestration)", "technology", "tradable permits", and "transportation". Tables were also established to report on other key aspects of the climate change issue such as science and adaptation, and international negotiations. Each Issue Table is expected to have produced an options paper by the fall of 1999.

Nova Scotia has been involved in the Issue Tables through its government and industry representatives.

Canada's Greenhouse Gas Emissions



1.5 Early Actions to Reduce Greenhouse Gas Emissions

While national and provincial strategies on climate change are being prepared, efforts are being undertaken to reduce greenhouse gas emissions. In Nova Scotia, for example, the provincial government, through its Departments of Natural Resources and the Environment, is a partner in nine climate change projects worth more than $ 1.3 million. These projects represent a step forward in creating public awareness and reducing emissions, but will not result in significant progress in and of themselves.

The federal government introduced a Climate Change Action Fund (CCAF) of $150 million over three years starting April 1, 1998. The CCAF provides support to four types of activities:

1) Public Education and Outreach;
2) Science, Impacts and Adaptation, to research the science of climate and climate change and impacts;
3) Technology Early Action Measures (TEAM), to support greenhouse gas reduction initiatives by businesses; and
4) Foundation Analysis, to promote work on assessing the options for reducing greenhouse gas emissions identified by the National Issue Tables.

Other climate change initiatives at the national level include the following:

- *The Federal Action Program on Climate Change (FAPCC)*, adopted in 1995. The FAPCC has two main goals. One is a 20 per cent reduction in greenhouse gas emissions from Federal Government operations by 2005, with a focus on transportation and energy-efficient buildings. The other is to stimulate sectoral initiatives, through energy research and development, the labeling of energy-efficient household products, and the promotion of energy-efficient buildings such as R-2000 homes.

- *The Federation of Canadian Municipalities (FCM) 20 per cent Club* was created in 1995. Municipalities that become members of this Club promise to reduce emissions of greenhouse gases to 20 per cent below their emissions in 1990 by the year 2005, or within 10 years of membership. The Halifax Regional Municipality (HRM) and New Glasgow have joined the FCM 20 per cent Club. The Club has recently joined its efforts to those of the International Council for Local Environmental Initiatives' Canadian Cities for Climate Protection Campaign. The united initiative is called Partners for Climate Protection: For a Better Quality of Life (PCP).

- *The Voluntary Challenge and Registry Program (VCR)* was launched in 1994. This government/industry partnership is intended to encourage industries and government agencies to voluntarily reduce their greenhouse gas emissions. The Program is now managed independently. It has more than 900 public and private registrants, 60 per cent of which have developed action plans and 20 per cent of which have submitted progress reports. Nova Scotia has 29 projects registered with the VCR. Examples of these Nova Scotia projects are

provided in Section 5. (All VCR registrations are publicly accessible in electronic form through the VCR web site, at http://www.vcr-mvr.ca.)

- *The Green Communities Association (GCA)* was established in 1996. The GCA is a national non-profit corporation. It coordinates information exchange and cooperation among community organizations that promote energy and water conservation, or other environmental measures in homes, businesses, institutions and governments. The GCA also develops agreements with conservation product suppliers and other partners, and it cooperates with Green Communities to set common goals and policies.

Examples of early action projects in Nova Scotia include the following:

- *The Light Better for Less! Program*: This Program encourages businesses in Nova Scotia to use energy efficient lighting systems by demonstrating the economic and maintenance benefits of doing so. Investments in energy-efficient lighting products can pay for themselves within one year and reduce greenhouse gas emissions immediately. The program is a partnership among the NS Department of Natural Resources, the NS Department of the Environment, NS Power Inc., the Illuminating Engineering Society of North America, and the EcoAction 2000 Program of Environment Canada. Participating businesses receive a certificate of recognition for their effort.

- *Climate Change Action Fund Projects*. Six projects have been approved in Nova Scotia. Aimed at educating the public about climate change, they are led by the Annapolis Valley Homebuilders Association, the Atlantic Coastal Action Program (ACAP) Cape Breton, Clean Nova Scotia (CNS), the Ecology Action Centre (EAC), and the Scientists and Innovators in the Schools (SITS). They will be delivered through workshops, radio and television programs, newsletters, home assessments, etc. Sponsors include the NS Links Program, the NS Department of the Environment, the NS Department of Natural Resources, Environment Canada, and Industry Canada.

1.6 History of Nova Scotia's Climate Change Strategy

In 1991, the Province of Nova Scotia developed a broad strategy on global warming, with the following five main elements:

1) public consultations, to design and implement the details of the strategy;
2) a multi-phase approach, to reduce greenhouse gas emissions and limit the growth of energy consumption;
3) research and development, on ways to reduce greenhouse gas emissions and to increase the absorption of carbon dioxide;
4) a management strategy, providing debits and credits for changes in greenhouse gas emissions; and
5) intergovernmental cooperation, to report on progress.

Public consultations were subsequently held in April and May 1992, and attracted approximately 100 people from several stakeholder groups. The participants represented the following sectors and interests: "academic and consulting", "business", "energy", "environment", "forestry", "mining", "petroleum", "resources", and "transportation". Stakeholder groups outlined concerns and proposed actions, which were summarized in a report published in 1993. Priorities for action discussed related to the following areas: education, waste reduction, energy use, the role of technology, government, business, transportation, and management of air emissions. These actions were related to the NS Energy Strategy, the Economic Strategy and the Sustainable Development Strategy.

The public workshops scheduled for November 1999 in Amherst, Halifax, New Glasgow, Sydney, Bridgewater, and Yarmouth build upon these earlier efforts. They aim at obtaining the views of various sectors and the general public on a more detailed and concrete climate change strategy that will set a direction for future greenhouse gas emission reductions in Nova Scotia.

1.7 Climate Change and the Public

Despite Canadians' strong concern for the environment, they have limited awareness or understanding of climate change as an issue. Climate change does not yet command the attention of Canadians to the same extent as other societal concerns such as health care, the economy, and education. The linkages between climate change and our economy, our health and other societal concerns are also not understood.

Public opinion research indicates that very few people are engaged in the issue of climate change. There is a perception that other issues are more important, and that the scientific and expert communities have not yet determined what is happening and what is needed to deal with the problem. Few are taking action to address climate change in their personal lives.

A study has shown that climate change is not a top environmental concern for Canadians. Study participants were more aware of air and water pollution problems, ozone layer depletion, and recycling.

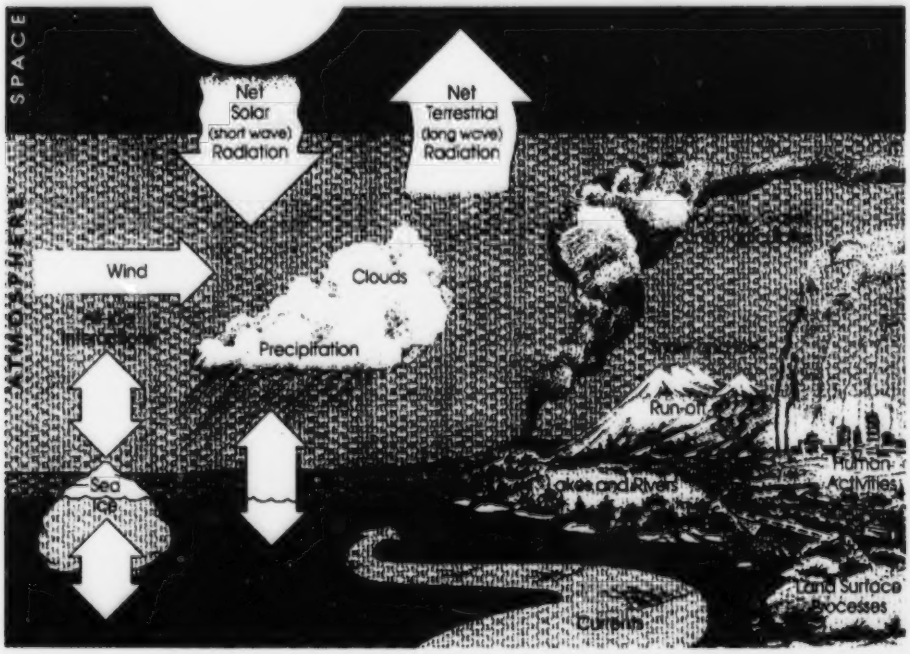
A number of reasons for this lack of awareness were identified. For example, participants felt that they did not have enough information about climate change, and its causes and impacts.

After learning that the activities of individuals were responsible for more than half of emissions, the attitude of participants shifted toward a better understanding of the need for individual action. However, they felt a lack of information on steps they could take to reduce greenhouse gas emissions and limit the impact of climate change.

2. Science

Climate Change is not a new issue. Concern about climate change led to the creation of the Intergovernmental Panel on Climate Change (IPCC) more than a decade ago. The Panel's second assessment report, published in 1995, provides an overview of the science of climate change. This assessment was produced by more than 1,000 experts from 50 countries, and more than 10 international organizations. One of their main conclusions was as follows:

> ***The balance of evidence, from changes in global mean surface air temperature and from changes in geographical, seasonal and vertical patterns of atmospheric temperature, suggests a discernible human influence on global climate.***



Greenhouse gas concentrations in the atmosphere continue to rise. For 10,000 years, carbon dioxide (CO_2) concentration in the atmosphere was around 280 ppm (parts per million). This concentration has increased since the industrial revolution and is now at 364 ppm. If the Kyoto reductions in greenhouse gas emissions (6 per cent below 1990 levels for Canada) are implemented, it has been estimated that global atmospheric CO_2 levels will reach 560 ppm (a doubling of pre-industrial CO_2 levels) around the year 2080.

The science of climate change is complex, involving an assessment of the interactions of the atmosphere, oceans, plants, soils, etc. Climate varies naturally. This has made it difficult to quantify contributions from human activities. While our understanding of climate change

continues to advance, key questions about the magnitude, speed and impact of human-induced climate change remain unanswered. As a result of this uncertainty, considerable research into the science of climate change is underway.

2.1 Scientific Consensus and Developments

Thousands of scientists around the world are involved in the study of climate change. New research developments summarized by Environment Canada indicate that global mean temperatures will increase by 1.0 to 3.5 degrees by the end of next century, and that sea levels will continue to rise (at an accelerated pace). The predicted global increase in mean temperature could lead to an increase of 5 to 10 degrees in annual mean temperatures in some areas of Canada. This temperature increase will also lead to other climatic changes, including changes in wind and precipitation patterns.

The crucial question will be how fast these changes will take place. It is the rate of change that we are most likely to be able to influence by taking action on this issue now. The slower the rate of change, the more time we will have to adjust to the changes.

The following provides examples of what scientists are saying about the past, present, and future climate. Appendix 7.2 provides listings for further readings on climate change.

World Meteorological Organization (WMO) - 1999 Statement

"Nineteen ninety-eight was by far the warmest year since worldwide instrument records began 139 years ago. No single year can indicate a change in climate, but a perspective of global data spread over a long period of time shows the world is in a period of warming. Even if 1999 should prove to be cooler than 1998, the trend towards warmer temperatures is indisputable. What portion of the warming is due to natural variability and anthropogenic (man-made) causes is a topic of continuing research. "

The WMO reports a 20 year warming trend and says an examination of global surface temperature anomalies for every year from 1860 to 1998 shows the following;

- The global temperature in 1998 was higher, by a substantial margin, than ever before on record;
- The second warmest year was 1997, and seven of the 10 warmest years have occurred in the 1990s;
- It was the 20th consecutive year with an annual global mean surface temperature that exceeded the 1961-1990 average;
- The global mean surface temperature has increased approximately 0.7 degrees since the late 19th century;
- The global temperature has risen in the past 20 years faster than in any other 20-year period; and

- There have been relatively frequent and strong El Nino/Southern Oscillation (ENSO) warm phase episodes, with only rare cool phase events in the latter part of the 20th century.

United Nations Environment Programme (UNEP)

- **If nothing is done to reduce emissions, current climate models predict a global warming of about 2 degrees between 1990 and 2100.** This projection takes into account the effects of aerosols and the delaying effect of the oceans. This oceanic inertia means that the earth's surface and low atmosphere would continue to warm by a further 1-2 degrees even if greenhouse gas concentrations stopped rising in 2100.

- **The range of uncertainty in this projection is 1 to 3.5 degrees.** Even a 1 degree rise would be larger than any century-time-scale trend for the past 10,000 years. Uncertainties abut future emissions, climate feedbacks, and the size of the ocean delay all contribute to this uncertainty range.

- **The earth's average sea level is predicted to rise by about 50 cm by 2100.** The uncertainty range is large - 15 to 95 cm - and changing ocean currents could cause local and regional sea levels to rise much more or much less than the global average. The main cause of this rise is the thermal expansion of the upper layers of the ocean as they warm, with some contribution from melting glaciers. Slightly faster melting of the Greenland and Antarctica ice sheets is likely to be balanced by increased snowfall in both regions. As the warming penetrates deeper into the oceans and ice continues to melt, sea level will continue rising well after surface temperatures have leveled off.

- **Regional and seasonal warming predictions are much more uncertain.** Although most areas are expected to warm, some will warm much more than others. The largest warming is predicted for cold northern regions in winter. The reason is that snow and ice reflect sunlight, so less snow means more heat is absorbed from the sun, which enhances any warming: a strong positive feedback effect. By the year 2100, parts of northern Canada and Siberia are predicted to warm by up to 10 degrees in summer.

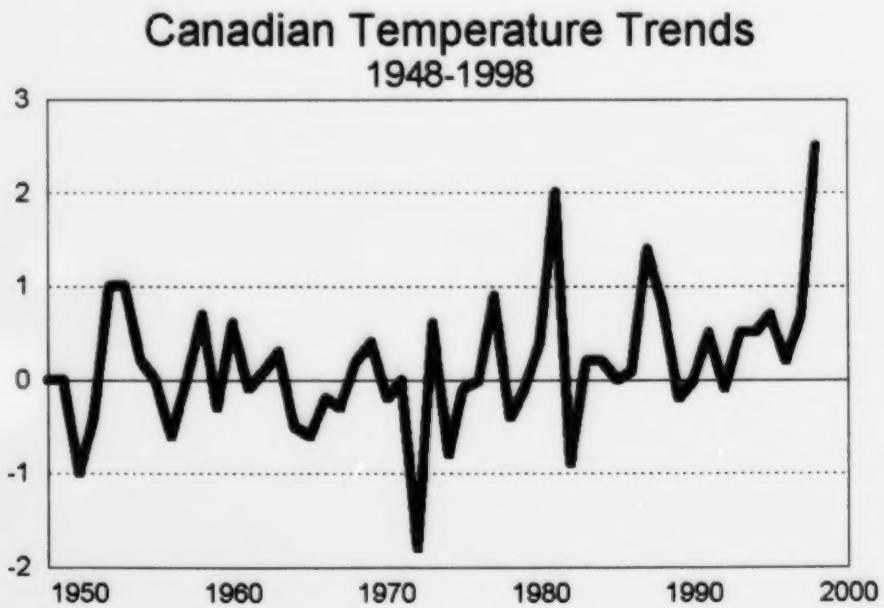
- **Inland regions are projected to warm faster than oceans and coastal zones.** The reason is simply the ocean delay, which prevents the sea surface from warming as fast as the land. The size of this delay depends on how deep any warming penetrates into the oceans. Over most of the oceans, the uppermost few hundred meters do not mix with the water beneath them. These upper layers will warm within just a few years, while the deep ocean stays cold. Water mixes down into the ocean depths in only a few very cold regions, such as the Atlantic south of Greenland and the Southern Ocean near Antarctica. In these regions, warming will be delayed because much more water needs to be warmed up to get the same temperature change at the surface.

- **Total precipitation is predicted to increase, but at the local level trends are much less certain.** Wintertime precipitation in the far north is likely to rise, but what happens in mid-latitudes and in the tropics depends very much on the details of the particular climate model and the emissions scenario, including the effects of aerosols, for example, significantly weakens the Asian summer monsoon in the two models which have so far run this experiment.

- **More rain and snow will mean wetter soil conditions in high-latitude winters, but higher temperatures may mean drier soils in summer.** Local changes in soil moisture are clearly important for agriculture, but models still find it difficult to stimulate them. Even the sign of the global change in summertime soil moisture - whether there will be an increase or decrease - is uncertain.

2.2 Is Climate Change Already Happening?

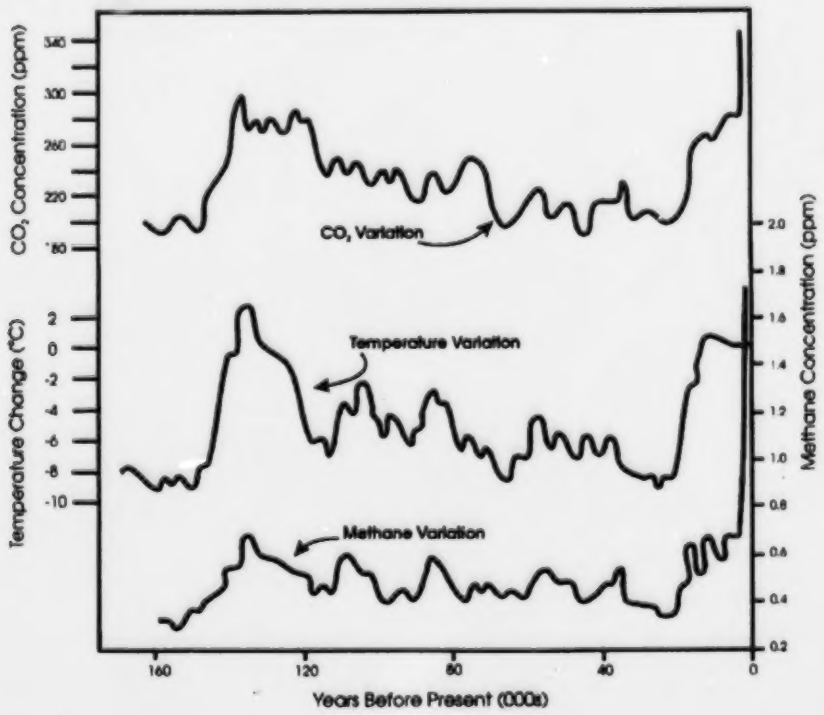
A variety of climatic changes and extreme events have been observed throughout the world and in Nova Scotia this century. The question for climate scientists is whether this is evidence of a changing climate and whether humans are causing such a change. The UNEP says "the evidence suggests that recent changes are unlikely to be entirely due to known sources of natural variability". It also suggests that "the pattern of change seems to point to some human influence on climate." At this point, scientists cannot yet conclusively attribute these observed changes to increased greenhouse gas emissions, mainly because of uncertainty over the ability of current climate models to simulate natural variability realistically.



According to a review of current research developments in climate change by Environment Canada, losses due to weather disasters are on the rise. During the past 15-20 years, extraordinarily severe floods, storms and other climatic events seem to have become more common. From 1989 to 1998, there was a sixfold increase in the number of severe weather insurance claims in Canada. The total cost of the 1998 eastern ice storm was greater than $ 1 billion.

Canadian climate scientists point to the following events as evidence that the climate is already changing:

- in the Arctic; ice is thinning and disappearing and faunal distributions are changing;
- one million hectares of trees in Alaska have died due to drought;
- (mountain) glaciers are disappearing;
- permafrost in Canada is receding northward, and thawing is reaching deeper than that reached during the medieval warm period;
- parts of the boreal forest, and parkland aspen are showing signs of climate stress;
- prairie grasslands are moving northward;
- in Greenland, and in small local ice caps in the eastern Arctic there is evidence that ice is receding;
- warming water temperatures of inland waters and associated impacts on aquatic species have been observed;
- damage from relative sea level rise and storm surges is a persistent problem on Canada's submerging coasts: Fraser Delta, and Atlantic Canada;
- a cooling off the coast of Labrador and less warming in Atlantic areas has been observed, as projected by climate models.



Greenhouse gases remain in the atmosphere for decades after they have been emitted. They continue to influence climate long after their release. Consequently, waiting for conclusive information on specific impacts of climate change before taking measures to reduce greenhouse gas emissions could pose serious risks

2.3 Further References - Please refer to the Appendices Section 7.2.

3. Expected Impacts, Especially in Nova Scotia

3.1 General

The impacts of climate change can be both positive and negative. It is the negative impacts we wish to limit, and at the same time be able to take advantage of the positive changes.

"Predictions" of Climate Change

• Large Stratospheric Cooling	• Virtually Certain
• Global Mean Surface Warming	• Very Probable
• Global Precipitation Increase	• Very Probable
• Reduction of Sea Ice	• Very Probable
• Arctic Winter Surface Warming	• Very Probable
• Summer Continental Dryness	• Probable
• Arctic Precipitation Increase	• Probable
• Rise in Global Mean Sea Level	• Probable
• Regional Vegetation Changes	• Uncertain
• Regional Climatic Details	• Uncertain
• Tropical Storm Increases	• Uncertain
• Details of Next 25 Years	• Uncertain

The rate of change is a significant concern, whether the change itself is seen as positive or negative. The rate of climate change expected is higher now and likely to continue to be higher than it has been at any point over the past 10,000 years. Global temperature changes between ice ages and inter-glacial periods are in the range of 4^{o} C. The most recent ice age ended about 10,000 years ago and it took that period of time for temperature to increase and climate to become what it is today. It is expected, however, to take less than 100 years for global average temperature to increase by 1 to 3.5 degrees.

Increases in temperature will in turn cause many other changes to the climate and to the ecosystems, which depend on it. More heat-related deaths are likely to occur. As well, the World Health Organization predicts that tropical diseases, such as malaria, dengue fever, and elephantiasis, will start spreading in North America in the next decades. Other changes, which are considered likely to be of particular concern in Nova Scotia, are discussed in more detail below.

3.2 Sea Level Rise

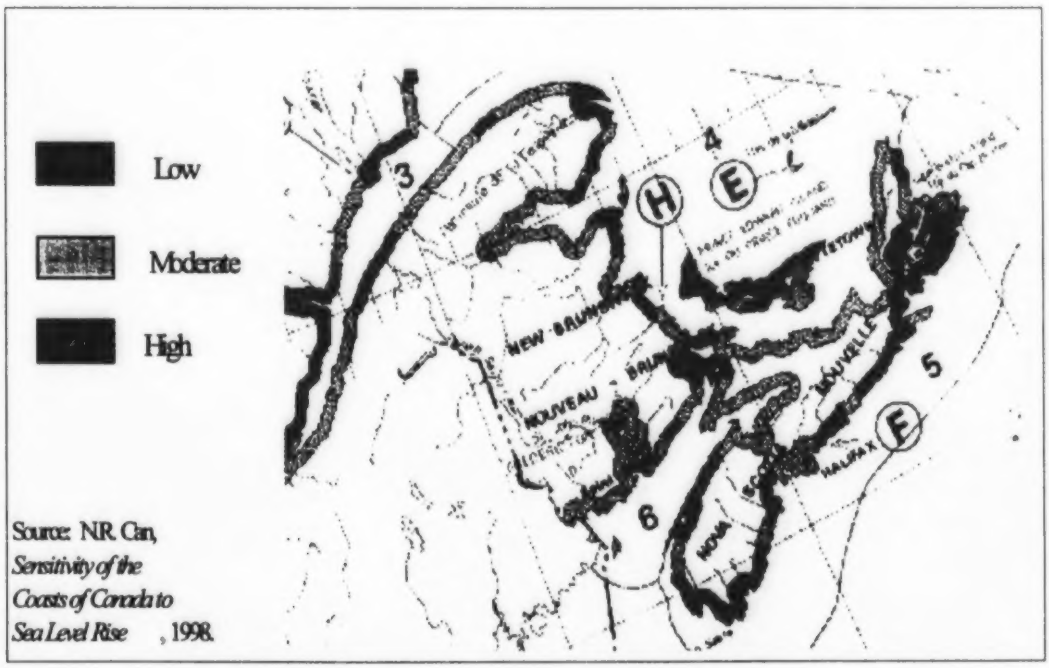
Sea level could rise anywhere from 30 cm, up to 1.5 m by 2100, leading to increases in coastal flooding and erosion. A 30-cm sea level rise could cause many US and Canadian beaches to retreat by 30 m. A relatively small rise in seawater levels vertically can cause large areas of land to be permanently covered.

A rise in sea level could have many impacts in coastal areas. For example, people may need to be relocated. In addition, coastal infrastructure may have to be repaired, replaced, or rebuilt further inland. Building and upgrading costs for permanent infrastructure, e.g., urban waterfront land, breakwaters, bridges, causeways, roads and railways could reach several billion dollars.

In Nova Scotia, agriculture may be particularly vulnerable to sea level rise. Dyked farmland, for example, will be affected, especially around Truro, Amherst, and in the Annapolis Valley. As well, salt water intrusions in ground and surface waters may occur. They would reduce the quantities of freshwater available for drinking and agriculture. Flooding from sea level rise could also affect the quality of agricultural land because of the salt content.

Sea level rise will also have particular impacts on certain ecosystems and species. Coastal wetlands, for example, are a crucial link in our ecosystems. Their roles as nursery grounds, water purifiers, erosion and flood controllers will be affected. Sea level rise and changes in salt content will also have serious impacts on many fish species and the fishery, as about 70 per cent of the fishery resources in the world depend on habitats in estuaries (where rivers meet the ocean) at some stage of their life cycle.

Sensitivity of Coastal Areas to Sea Level Rise



Source: NR Can, *Sensitivity of the Coasts of Canada to Sea Level Rise*, 1998.

3.3 Ecosystems and Wildlife

Climate change could have many impacts on ecosystems and species, in addition to those of sea level rise mentioned above. For example, changes in the timing and extent of ice formation and break-up may affect certain aquatic species. While otters may benefit from reduced sea ice, seal populations may decrease because of a lesser availability of sea ice for breeding. It has also been estimated that a 3 degree increase in temperature could lead to a 39 per cent decrease in the number of wetlands found in parks.

Other impacts of climate change include modifications to the habitat of migratory birds. The distribution of their species and reproductive cycle may be affected.

3.4 Forests and Forestry

Some estimates indicate that the boreal tree line could move 500 miles northward, with the southern limit of boreal forests being replaced by temperate forests. The environmental conditions (habitat) necessary for many tree species to grow may change faster than the rate at which trees can spread to areas with suitable habitats. Nova Scotia's forests are expected to be directly affected by this shift.

Any change in temperature and precipitation patterns will put additional stresses on our forests. For example, insect pests migrate faster than do trees. They are thus likely to spread. The frequency and intensity of insect outbreaks (such as the spruce budworm) is also expected to increase. As well, forest fires, especially in areas already sensitive to drought, may become more prevalent.

At the same time, there are indications that an increase in forest productivity in Atlantic Canada of about 15 per cent is possible as a result of warmer temperatures.

3.5 Fish and Fishery

Many fish species are sensitive to changes in the climate. Some may be directly affected by a change in temperature. Others, such as predator species, may be affected indirectly because their food source has declined in population or migrated as a result of a change in water temperature. Fish distribution, migratory patterns and survival rates are expected to be affected by changes in temperature and streamflows and currents along Canadian coasts. For example, the ratio of groundfish to fish that live closer to the surface is likely to change. The boundaries of cod populations could also move. Generally speaking, many fish species are temperature sensitive and would either move to a more favorable climate as water temperature changes, or would decline in numbers. The economic and social upset caused by the recent collapse of the groundfish stock in Atlantic Canada is an example of what could happen as water temperatures change in the future.

Lobsters may also be affected. If water temperature increases by 2-3 degrees, the ability to catch lobsters may also improve. The duration of the fishing season and the fishing effort will have to be adapted to keep this fishery sustainable. As well, if water temperatures increase, lobsters may molt twice a year instead of once a year in more areas than they do now. Typically, when this happens, lobsters are of poor quality and the lobster fisheries are usually closed.

The behavior of sea scallops may be affected by temperature increases. They may become more susceptible to predation. Shallow waters and the inshore fisheries would be most impacted.

3.6 Aquaculture

Aquaculture, in terms of common species currently farmed in Nova Scotia, would benefit from higher water temperatures during the winter months. Should water temperatures rise as some predict, Atlantic salmon aquaculture, for example, would likely be feasible in more areas. Until now, salmon aquaculture in the Atlantic Region has been limited by low temperatures, and it has had to rely on sources of warm water from power plants or from deeper layers of water offshore.

The farming of certain other species could also be more productive. Oyster aquaculture may be easier or cheaper. As well, mussels may grow faster but the most suitable period to farm them will likely change. Conversely, warmer temperatures during the summer, particularly higher than 17 degrees, over time would have a negative impact on trout and salmon. Above 17 degrees fish become stressed and are generally removed from feed, thus delaying growth. In some cases, mortality rates could rise. Overall, it is expected that rising temperature combined with nutrification and the introduction of foreign (or exotic) species will make the system more vulnerable.

3.7 Agriculture

Agriculture is very weather-dependent. It is no surprise, therefore, that it is expected to be most influenced by changes to the growing season, droughts, severe storms, excess moisture that could lead to more disease, and less predictable weather during the growing season. For example, these changes may require farmers in Nova Scotia to be more selective in the crops we grow and will provide new challenges for water use management.

Other factors could affect agriculture. For example, salt water could enter groundwater sources of freshwater. Insect outbreaks may also last longer and be more severe.

Some socio-economic effects from agricultural impacts have been assessed. For example, damages to Atlantic Canada's agricultural resources have been estimated at $20 to $88 million/year as concentrations of carbon dioxide in the atmosphere double. As well, the Prairies and the US Midwest could become arid regions. The changes in their agricultural productivity will also affect Nova Scotia because we rely heavily on their crops.

3.8 Other Industries

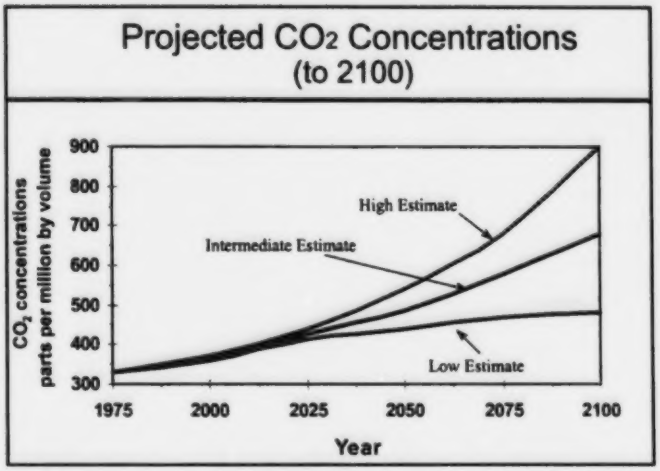
A change in the number of ice-free days would have an impact on marine transportation and the oil and gas industry. Ice-free days refer to the number of days in a given year that a body of water such as the Northumberland Strait or the St Lawrence Seaway is free of ice. For example, there may be more marine traffic if the duration of sea-ice covering decreases, and marine transportation costs may be reduced. On the other hand, we would have to consider the impact on the Port of Halifax if more shipping traffic can go directly to Montreal.

As well, changes in precipitation patterns will affect the generation of hydroelectricity. Preliminary studies suggest that spring run-off will occur earlier in Labrador, that rivers and lakes will peak at a higher level, and that summer months will experience much lower flows.

Many other industries, including tourism and primary resource industries, are dependent in some way on water supply or water quality. Many of these affected industries have been important parts of rural economies for decades and even centuries.

4. Guiding Principles

The Government of Nova Scotia has concluded that the risk of climate change merits action. The goal of the NS Strategy on Climate Change is to provide a broad framework for future action, establish principles, identify criteria for successes, and answer key questions about climate change. The level and areas of effort needed will have to be determined and reflected in the strategy. The completed strategy will guide the development of an action plan.



Workshop participants are asked to provide input on the development of a climate change strategy for Nova Scotia. We would like you to consider guiding principles that would shape the development of the strategy. These principles will guide the specific short, medium, and long-term actions that will be identified to reduce greenhouse gas emissions.

This section introduces some examples of principles that have been used in other provinces to develop their strategies. They are provided only to stimulate debate on the topic, and you are invited to discard them or add any other principle that you might find important. A set of questions is included after each principle and at the end of this section, to facilitate the discussion.

4.1 Examples of Principles

4.1.1 Immediate action is needed to limit the impact of climate change.

Previous sections have shown that the impacts of climate change may be serious. Some will be unavoidable, but some effects could be limited. Measures have already been taken at the provincial, national, and international level. Some of these are referred to in Section 1 of this workbook. However, they cannot and will not halt or reverse emissions, and more specific and immediate actions are therefore needed.

Climate change is a global issue, with long-term impacts, but its impacts will also be felt at the local level, including in Nova Scotia. The sectoral discussion to follow will show how small changes, in energy use, for example, can have substantial impacts in reducing greenhouse gas emissions.

In areas where there are uncertainties about climate change science, a precautionary approach must be taken. Actions must be implemented despite the uncertainties, especially when the risks

are substantial. This point is particularly important because climate changes that appear minor on their own will have larger impacts when seen in combination with other changes. In this context it is important to consider that there are a number of initiatives, such as some retrofitting and energy conservation, which can have short payback periods and are considered to benefit us in addition to their impact on GHG emissions. The issue here is how far do we go beyond these "no regrets" actions with guaranteed short-term benefits?

What Do You Think?

1.Should principle 4.1.1 be adopted?
2.Should this principle be discarded?
3.Would you define it differently?
4.What relative priority would you give this principle?
5.Do you have any other comment about this principle?

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4.1.2 We all need to act and cooperate.

As will be discussed further, in Section 5, many sectors are involved in the emission of greenhouse gases. We will all feel the impacts of climate change and need to work together to limit them.

Some sectors and some provinces produce more greenhouse gas emissions than others. At the same time, some sectors and provinces will feel the impact of climate change more strongly than others will. Some will suffer economically from reductions in emissions, others will benefit. Those suffering less or benefiting from climate change or reductions in emissions should assist those that stand to suffer more.

What do you Think?

1.Should principle 4.1.2 be adopted?
2.Should this principle be discarded?
3.Would you define it differently?
4.What relative priority would you give this principle?
5.Do you have any other comment about this principle?

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4.1.3 We need to identify the costs and benefits of proposed actions

We do know that we all play a part in causing GHG emissions. We also know that we will have to adapt our ways of living and conducting business to achieve reductions in greenhouse gas emissions. We do have options for achieving these reductions. Some may require substantial efforts or be costly. Others will provide additional benefits and open new business avenues or promote Nova Scotia's economic competitiveness.

For each action considered, therefore, it will be important to identify those who stand to benefit from the proposed action, those who stands to lose, and what can be done to ensure that no one bears an unreasonable burden of the change. This will allow us to assess the resulting overall impact for Nova Scotia of either acting or not acting on the suggested change. To make this principle work, it will be important to work through this process and not stop whenever a sector or business or individual is identified who will be burdened by the proposed action. A complete assessment of all relevant factors is needed to make a decision about what is in the best interest of all Nova Scotians.

The following are some of the benefits from reductions in greenhouse gas emissions (beyond limiting the impact of climate change):

- Fewer greenhouse gas emissions will be accompanied by reduced smog and acid precipitation. This will result in fewer health problems, and less damage to ecosystems..

- Reducing the use of cars or other vehicles will, in turn, result in less car maintenance. It will also reduce traffic and municipal road infrastructure costs. Fewer accidents will take place and pollution (including ground level ozone) will decrease.

- According to some estimates, four times as many jobs are created by energy efficiency as by energy production.

- Businesses using more energy-efficient technologies will increase their competitive advantage.

What Do You Think?

1.Should principle 4.1.3 be adopted?
2.Should this principle be discarded?
3.Would you define it differently?
4.What relative priority would you give this principle?
5.Do you have any other comment about this principle?

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4.1.4 Adaptation needs to be facilitated

Reductions in greenhouse gas emissions will need to be encouraged. In other words, the current economic, political and social climate has so far not been able to achieve reductions in our emissions. Mechanisms to accomplish reductions in priority areas are needed. They could include cooperation (addressed above), coordination (considered below), research, education, tax or other incentives, regulations, and funding. Mechanisms could be developed and implemented by governments, businesses, non-governmental groups, institutions or a combination.

What Do You Think?

1.Should principle 4.1.4 be adopted?
2.Should this principle be discarded?
3.Would you define it differently?
4.What relative priority would you give this principle?
5.Do you have any other comment about this principle?

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4.1.5 Actions must be designed with a strategic approach

Actions needed to reduce greenhouse gas emissions should not merely be defined. Their intended goals should be determined. The parties responsible for implementing them should be identified, and their time frames and costs assessed. Priorities for action should be set, for example, by identifying where most reductions can be achieved. Finally, the implementation of actions should be monitored and necessary adaptations put in place.

What Do You Think?

1. Should principle 4.1.5 be adopted?
2. Should this principle be discarded?
3. Would you define it differently?
4. What relative priority would you give this principle?
5. Do you have any other comment about this principle?

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4.1.6 Agreement on long-term goals will help set shorter-term goals

Another strategic approach to be considered is the setting of long, medium and short-term goals. They will assist in guiding the implementation of the Provincial Strategy on Climate Change.

As we will se in Section 5, there are a number of sectors involved with greenhouse gas emissions. As we discussed in Section 3, there are many different sectors that will suffer from the impacts of climate change. As a result, participants will likely address numerous interests and needs in setting goals. If we can first agree on long-term goals, it will be easier to define medium and short-term measures that will be appropriate and effective.

What Do You Think?

1. Should principle 4.1.6 be adopted?
2. Should this principle be discarded?
3. Would you define it differently?
4. What relative priority would you give this principle?
5. Do you have any other comment about this principle?

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4.1.7 A coordination body is needed

Some form of coordination body is needed to steer action, monitor successes, and provide information and networking on the science of climate change, policies, technological developments, activities, etc.

What Do You Think?

1. Should principle 4.1.7 be adopted?
2. Should this principle be discarded?
3. Would you define it differently?
4. What relative priority would you give this principle?
5. Do you have any other comment about this principle?

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4.2 Other Principles

Please let us know about any other principles that you would like to add. These principles are crucial as they will guide us in selecting appropriate policies and actions. These principles will ultimately shape both the strategy and a more specific action plan. How much of a leadership role should Nova Scotia play. How much should we be guided by economic considerations, how much by social, and how much by environmental concerns? How far do we look into the future? How do we value future costs and benefits? Space is provided below for you to write these principles.

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5. Sectoral Discussions

There are likely to be as many views on what a Nova Scotia strategy on climate change should consist of, as there are individuals affected. To stimulate discussion on policy options, a number of options considered in other jurisdictions have been outlined in appendix II.

Some believe that significant reductions will inevitably come at a cost. There are concerns that emission reduction measures will slow down our economy. Others take the view that there are a number of cost-effective measures that can help stimulate the economy, and that there are others that have a limited overall cost associated with them. At the same time, there are costs associated with the expected impacts. Again, there appears to be a range of views on what those costs will be. There is also the cost of adaptation. Finally, there are benefits from reducing energy use from fossil fuels other than the reduced impact on climate change. These benefits range from increased competitiveness and enhanced productivity to reduced emissions of other pollutants. These factors must all be taken into account in assessing what contribution each sector can make to address the issue of climate change.

Nova Scotia GHG Emissions 1995

Sector	Primary Energy	End Use Energy
Power Generation	37.5 per cent	----------
Transportation	30.0 per cent	30.0 per cent
Industrial	9.8 per cent	21.8 per cent
Residential	8.0 per cent	22.1 per cent
Commercial	4.5 per cent	15.9 per cent
Other	10.0 per cent	10.0 per cent

Carbon dioxide (CO_2) accounts for 75 per cent of human-induced greenhouse effect. Between 1990 and 1997, emissions increased about 13 per cent. We would therefore expect a slightly higher per person emission of carbon dioxide today.

In 1990 and 1996, Nova Scotia's emissions were estimated at 19 million tonnes of CO_2 equivalents. The province's emissions by 1998 were slightly below its 1990 emissions level. It is expected that by 2010, without reduction measures, the Province's emissions will be 12.8 per cent above the 1990 level, although this estimate will change depending on the impact of the Sable Energy Offshore Project. A reduction of 16.5 per cent in Nova Scotia emissions from forecasted levels would be required to meet a target of six per cent below 1990 levels.

GHG emissions result from both production and consumption of fossil fuels. Producers can reduce emissions by increasing the efficiency of production or by switching energy sources. Consumers generally have a larger impact on GHG reductions through the choices they make. For example, Dartmouth Imperial Oil refinery uses about 9 per cent of the crude oil it receives to produce finished petroleum products. The remaining 91 per cent is within the control of the

consumer. Various sectors are responsible for greenhouse gas emissions in Nova Scotia. In this section, a description is provided of the six main sectors and their contribution to emissions. The sectors considered are as follows: "energy", "transportation", "buildings", "manufacturing and processing", "agriculture and food production", and "forestry and forest products".

Examples of successful efforts to reduce greenhouse gas emissions are included in this section for each sector. These success stories are only meant to stimulate discussion. They illustrate some of the options that are available and do not constitute an exhaustive list of feasible ways to reduce greenhouse gas emissions.

Questions are included at the end of each sectoral discussion to identify priorities and specific actions within the sector that could lead to reductions in greenhouse gas emissions. Where appropriate, questions related to impacts and adaptation are also included. The general set of questions is as follows:

1. Who can contribute to reducing greenhouse gas emissions in the sector?
2. Will adaptation be an important issue for the sector? What opportunities exist to facilitate adaptation?
3. What actions can be taken by the sector? *For example*, is there a need for:
    - research activities (e.g., on how to improve energy efficiency)?
    - encouraging individual or business action (e.g., through tax incentives)?
    - government action (e.g., to improve the energy efficiency of its own operations)?
    - public awareness or education?
    - partnerships between government and the private sector?
4. How can these actions be accomplished and who could be responsible for which activity?
5. What are the possible barriers that need to be removed or incentives that are required to facilitate the action?
6. What are the economic opportunities resulting from each action proposed to reduce greenhouse gas emissions?
7. What goals should we aim for and how should we measure success? What are the short, medium and long-term measures that can be taken?
8. Should there be a coordinating body to facilitate actions by the sector?
9. Are there additional factors that should be taken into account?

Space is provided at the end of each sectoral discussion for you to write notes, answers and comments relating to these questions and other matters you find relevant to a climate change strategy for the sector. You are encouraged to submit these responses to the Climate Change Working Group, Voluntary Planning, Suite 600, 1690 Hollis St., Halifax B3J 3J9, Tel: 902-424-8644 e-mail: Fraserri@gov.ns.ca., and to bring and address them at the workshops in November. We kindly ask you to submit your responses at the latest on **Friday, December 3, 1999**, so that they can be included in the report and considered in the strategy-drafting process. An electronic version of the workbook is available at www.gov.ns.ca/natr.

5.1 Energy (coal, oil and gas, biomass, electricity and pipelines)

5.1.1 Contribution to Greenhouse Gas Emissions

Energy, and particularly energy from fossil fuels, is important to Nova Scotia's economy. More than 80 per cent of our electricity is generated from coal and oil. Nova Scotia's coal industry has been an important part of our economy, generating income and employment while providing energy for the majority of our electricity production in recent years.

Soon, Nova Scotia will have a new source of energy – natural gas from our offshore region. This new energy source will also be used to produce electricity and for other industrial, commercial and residential uses.

Nova Scotia has a special stake in the current debate about climate change and reducing greenhouse gas emissions because of the key role fossil fuel has played in the economy of our province.

In 1996, the last year for which figures are available, electricity generation accounts for almost 40 per cent of Nova Scotia's greenhouse gas emissions. The majority of the emissions were in the form of carbon dioxide.

There are three ways to reduce emissions from electricity production:

- reduce activities which use electricity
- improve energy efficiency both in the production and distribution of electricity and in the consumption of electricity by energy users
- use less carbon-intensive forms of electricity generation

Options for reducing emissions from electricity generation include switching to less carbon intensive energy such as natural gas, using biomass and other forms of renewable energy such as wind and solar power, increasing the efficiency of generation, and using co-generation by industries. It is important to keep in mind that the emissions are ultimately caused by the use of electricity in our homes, buildings, and industries and that conservation plays a crucial role in reducing emissions from generation of electricity.

This section looks primarily at electricity generation. Opportunities for increasing energy efficiency and conservation are considered with other sectors. The Sable Offshore Energy Project, where it replaces more carbon intensive fuel such as coal or oil, is seen as a source of energy that will assist with reducing greenhouse gas emissions. At the same time, it will create emissions through leakage, flaring, and energy used in processing the gas, etc. The amount of natural gas used in Nova Scotia, and the fuels it displaces will, in combination with the emissions released by the project determine weather the project produces a net increase or decrease in GHG emissions.

Biomass is currently used in Nova Scotia to meet energy needs of pulp and paper mills, some greenhouses, and other facilities. It is a source of energy that does not contribute to GHG emissions, even though the burning of wood waste and other biomass does result in carbon dioxide emissions. The reason for this is that biomass decays and in the decay process releases these gases in any event. Burning biomass therefore does not add any additional GHGs to the atmosphere, it merely makes use of the energy released in the process.

5.1.2 Success Stories in Reducing Greenhouse Gas Emissions

Capturing Landfill Methane

Landfills in Canada produce 1 million tonnes of landfill gas or methane every year, and the production of methane can continue for 30-50 years after landfilling. In 1995, landfills accounted for 26 per cent of Canada's methane emissions.

Eltec Incorporated and Edmonton Power have been harnessing methane released at landfills and burning it to produce electricity. Two units of Edmonton's Clover Bar Generating Station have been modified so that the Station can process methane. The capital costs of the changes have been modest. Enough electricity has been generated to satisfy the demand of 41,000 homes. There was a greenhouse gas emissions reduction equivalent to 181,500 tonnes of carbon dioxide.

Nova Scotia Power Inc. and Offset

Nova Scotia Power Inc. is participating with other Canadian utilities in a greenhouse gas offset project in British Columbia. The Norseman Landfill Gas project in Surrey, BC, is generating electricity from landfill gas. The most significant benefit of this project is that it will keep landfill gas, which is a much more potent greenhouse gas than carbon dioxide, out of the atmosphere and use it to replace fossil fuels.

Morgan Falls Power Company and VCR

The Morgan Falls Power Company is a private hydroelectricity production company. It began operations in 1998 and reduces carbon dioxide emissions in Nova Scotia by 4,000 tonnes annually. It is replacing electricity that would have otherwise been produced by the combustion of coal. This small hydroelectric facility, built at Morgan Falls, New Germany, was designed in a way that it does not interfere with fish living in the LaHave River.

Solar Hot Water Retrofits

A number of domestic solar hot water systems were installed in Bedford with the assistance of Natural Resources Canada. They have met 33 per cent of the hot water needs of participating residents.

Green City

This program to reduce energy consumption is taking place in Toronto. The program promotes the planting of trees in urban backyards, as trees provide cooling shade in the summer and act as windbreaks in winter. Advice is given to residents on positioning trees, and more than a thousand trees have been planted through the program.

Emissions Trading

In the United States, Niagara Mohawk Power Corp. (NMPC) traded its carbon dioxide allowances for the sulfur dioxide allowances of Arizona Public Service (APS). NMPC removed its sulfur dioxide allowances permanently from the emissions trading market by donating them to non-profit environmental organizations. The company also received tax benefits from the donations and reinvested them in projects to reduce carbon dioxide emissions.

Nova Scotia Power Inc. and the Voluntary Challenge and Registry Program (VCR) and Offset

Nova Scotia Power Inc. is one of the many businesses that are participating in the Voluntary Challenge and Registry Program (VCR). According to the company, the main sources of energy used to produce electricity in Nova Scotia are currently coal, oil and hydro. Nova Scotia Power Inc. has been looking into means of replacing sources of power to reduce emissions of greenhouse gases. The company may be able to use natural gas from the Sable Offshore Energy Project and coal-bed methane as a source of energy. The Tufts Cove Generating Station will be capable within one year of burning natural gas in addition to, or in place of, heavy fuel oil. Other sources of energy are under investigation or already used. They include wood burning, and non-emitting sources of power such as small hydroelectric facilities, solar power, and wind power.

When fueled by natural gas, carbon dioxide emissions will be reduced by about one-third for the same amount of generation, from the emission resulting when using heavy fuel oil.

5.1.3 What do you Think?

1. Who can contribute to reducing greenhouse gas emissions in the energy sector?
2. What actions can be taken by the energy sector? For example, is there a need for:
    - research activities (e.g., on how to improve energy efficiency)?
    - encouraging individual or business action (e.g., through tax incentives)?
    - government action (e.g., to improve the energy efficiency of its own operations)?
    - public awareness or education?
    - partnerships between government and the private sector?
3. How can these actions be accomplished and who could be responsible for which activity?
4. What are the possible barriers that need to be removed or incentives that are required to

facilitate the action?

5.What are the economic opportunities resulting from each action proposed to reduce greenhouse gas emissions?

6.What goals should we aim for and how should we measure success? What are the short, medium and long-term measures that can be taken?

7. As an example, how could we reconcile the opportunities from oil and gas production in Nova Scotia with the need to reduce GHG emissions?

8.Should there be a coordinating body to facilitate actions by the sector?

9.Are there additional factors that should be taken into account?

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5.2 Transportation (personal, commercial and institutional)

5.2.1 Contribution to Greenhouse Gas Emissions

The transportation sector accounted for approximately 27 per cent of Nova Scotia's greenhouse gas emissions in both 1990 and 1996. These emissions consisted mostly of carbon dioxide. About 50 per cent of these emissions are from personal vehicle use.

1999 Vehicle Emissions

Model	Litres/year	Tonnes CO_2/year	Tonnes CO_2/10 years
Golf Diesel	1012	2874	28 740
Honda Civic	1486	3507	35 070
Ford Taurus	2013	4751	47 510
Toyota 4Runner	2346	557	55 370
Ford Windstar	2377	5610	56 100
Ford Expedition	3034	7160	71 600

5.2.2 Success Stories in Reducing Greenhouse Gas Emissions

Vanpooling

Green Rider and other vanpooling businesses encourage commuters to travel during the week between several locations on the Eastern Shore or the Annapolis Valley to the Halifax Regional Municipality. Using this service allows people to use their car less often or have one car less at home. It can result in significant reductions in greenhouse gas emissions for individuals who can take advantage of this opportunity. It also saves participants thousands of dollars compared to single occupant vehicle travel.

Park & Ride

A Park & Ride project has been implemented in Metro Halifax by Metro Transit and the Canada-Nova Scotia Cooperation Agreement on Sustainable Economic Development (SEDA). A coordinator oversees the project and seeks the support of mall and other landowners. Commuters who live too far from bus stops can park their cars at 11 sites and take the bus for the remainder of their trip, reducing the number of cars on downtown roads.

It has been estimated that traveling in a fully occupied diesel bus uses, per person, one-third of the fuel required to travel in a car alone.

Cycling Lanes

Approximately 60 kilometers of cycling lanes were set up in Saanich, British Columbia. They are connected to cycling networks in adjacent municipalities. Bicycle racks were also installed for municipal workers.

You can save approximately 1,425 liters of gasoline, or $ 850 on average in fuel cost alone, every year by biking to work instead of driving.

Greenest City

One of the activities under this project has been the Safe Routes to School program. Parents take turns accompanying children to school by forming a walking school bus with them. This addresses the safety concern that often otherwise motivates parents to drive children to school even where the children live within walking distance. This type of activity was recently tested in both a rural and a suburban area.

Other Actions That Can Make a Difference

Simple actions that can significantly reduce greenhouse gas emissions include the following:

- *Use your car less*: For every 100 Km you do not drive, you will reduce your CO_2 emissions by 26 kg or 11 liters.

- *Avoid driving too fast*: Most cars use about 10 per cent more gas when driven at 100 km/h than when driven at 90 km/h.

- *Use your car more efficiently*: In the winter, use a timer that will turn on the block heater just before you intend to drive. Turn off or reduce your use of your air conditioner (air-conditioning uses an extra 5-15 per cent of gas per km). Avoid idling; restarting your car's engine takes a lot of gas, but idling for 15 seconds requires more gas than restarting the engine. Avoid "flooring" the gas pedal when starting from a dead stop, or you will consume 50 per cent more fuel than if you accelerate gradually.

- *Use more fuel-efficient vehicles:* Smaller cars tend to be more fuel efficient (they use less gas/Km) than mini-vans, sports cars, and light trucks. Own the type of car that is right for 90 per cent of the use, not for 10 per cent of the use. Hybrid vehicles, and other vehicles with a fraction of the emissions of standard cars will soon be available.

- *Keep your car well maintained*: A car that is not properly maintained can increase fuel consumption by 50 per cent. A vehicle that is poorly tuned can emit as many pollutants as 20 properly tuned cars.

Some employers may also promote modes of transportation that emit fewer greenhouse gases. Some are offering shuttle services for their staff. Others may be willing to offer the option of a free bus pass instead of free parking to their employees.

Other transportation initiatives that would assist in reducing greenhouse gas emissions include increases in fuel tax, creating a greenhouse gas emission tax, introducing alternative or improved fuels and alternative transportation technologies, and developing pedestrian and bicycle support strategies.

5.2.3 Adaptation

Assuming the impacts outlined in section 3 come to pass, including sea level rise, and more extreme weather events, adaptation may be an important part of a climate change strategy for the transportation sector. The anticipated climate changes could have implications for bridge construction, road construction, ferry services among others. Most forms of transportation are sensitive to weather in some form or another.

An example of adaptation in the Maritime Provinces is the Confederation Bridge between New Brunswick and Prince Edward Island. This bridge was designed and constructed assuming a one meter rise in sea level over the expected 100-year life-span of the bridge.

5.2.4 What Do You Think?

1. Who can contribute to reducing greenhouse gas emissions in the transportation sector?
2. Will adaptation be an important issue for the sector? What opportunities exist to facilitate adaptation?
3. What actions can be taken by the transportation sector? For example, is there a need for:
    - research activities (e.g., on how to improve energy efficiency)?
    - encouraging individual or business action (e.g., through tax incentives)?
    - government action (e.g., to improve the energy efficiency of its own operations)?
    - public awareness or education?
    - partnerships between government and the private sector?
4. How can these actions be accomplished and who could be responsible for which activity?
5. What are the possible barriers that need to be removed or incentives that are required to facilitate the action?
6. What are the economic opportunities resulting from each action proposed to reduce greenhouse gas emissions?
7. What goals should we aim for and how should we measure success? What are the short, medium and long-term measures that can be taken?
8. Should there be a coordinating body to facilitate actions by the sector?
9. Are there additional factors that should be taken into account?

5.3 Buildings (Residential, Commercial, and Institutional)

5.3.1 Contribution to Greenhouse Gas Emissions

The building sector accounted for approximately 16 and 14 per cent of Nova Scotia's greenhouse gas emissions in 1990 and 1996 respectively. With emissions from electricity consumption included, the building sector's contribution to GHG emissions is actually closer to 40 per cent. The sector released mostly carbon dioxide but a large proportion was also accounted for by nitrous oxide (N_2O).

5.3.2 Success Stories in Reducing Greenhouse Gas Emissions

Voluntary Challenge and Registry Program (VCR)
Most of the businesses and institutions registered for this program in Nova Scotia have committed to improving the energy efficiency of their buildings.

Participants include the following: Atlantic Shopping Centers, In Fine Company, Trade Centre Limited, Regional School Boards (Annapolis Valley, Cape Breton-Victoria, Chignecto-Central, Halifax, and Southwest), Acadia University, the Nova Scotia Community College - Annapolis Valley Campus, University College

of Cape Breton, the Cove Guest Home, Northwood Care Incorporated, the Nova Scotia Government, Nova Ski Ltd. (Ski Martock).

Energy Performance Contracting

The goal of energy performance contracting is to make large buildings (e.g., schools, hospitals, nursing homes, commercial buildings, government buildings, etc.) more energy-efficient. Upgrades can be performed to ventilation, air conditioning, heating, alarm, lighting, and water management systems. Potential lifestyle savings are also considered.

Following an energy audit of the building to identify opportunities for energy saving, a proposal is written and a feasibility study is performed. The plan is then implemented and training is offered to building operators and occupants. The whole project is paid for through savings on the energy bill.

A project completed in 11 schools of the former Shelburne County District School Board saved the Board 36 per cent of its electricity bill and 51 per cent of its oil bill. These energy savings translated into $68,000/year savings (predicted savings were $44,100/year). The project was paid out within four years (predicted payoff time was six years).

Other buildings that have become more energy-efficient and have reduced their greenhouse gas emissions through this process include the following: the Public Archives, the World Trade and Convention Centre, the Maritime Museum of the Atlantic, in Halifax, and the Marconi Campus of the Nova Scotia Community College in Sydney.

EnviroHome and R-2000

R-2000 homes are a type of energy-efficient homes. Nova Scotia has the largest number of R-2000 homes in Canada. Since their inception in the province, more than 1,000 have been built. More new homes are also taking advantage of passive solar heat and are reducing heating costs and GHG emissions as a result.

EnviroHomes are a special type of R-2000 home. Six of them have already been built in Nova Scotia. In 1998, one of the EnviroHomes designed by a Kentville-based company in the Annapolis Valley was opened to the public for information.

Energy Efficiency Office Staff

The City of Toronto has been undertaking retrofit projects through its Better Buildings Partnership. The goal of the projects is to reduce energy use and increase water efficiency. Savings in the order of $3 billion per year are expected. As well, the City plans to reduce its CO_2 emissions by approximately 1.8 million tonnes per year. Building air quality and comfort are added benefits of the retrofits. The projects include educational components for building operators and occupants.

5.3.3 Adaptation

The issue of adaptation may be relevant to the building sector as well. As an example, should there be restrictions on development in coastal areas and other areas that will be more susceptible to flooding if sea levels rise? What about the ability of buildings to withstand stronger and more frequent storms?

5.3.4 What Do You Think?

1. Who can contribute to reducing greenhouse gas emissions in the building sector?
2. Will adaptation be an important issue for the sector? What opportunities exist to facilitate adaptation?
3. What actions can be taken by the building sector? For example, is there a need for:
    - research activities (e.g., on how to improve energy efficiency)?
    - encouraging individual or business action (e.g., through tax incentives)?
    - government action (e.g., to improve the energy efficiency of its own operations)?
    - public awareness or education?
    - partnerships between government and the private sector?
4. How can these actions be accomplished and who could be responsible for which activity?
5. What are the possible barriers that need to be removed or incentives that are required to facilitate the action?
6. What are the economic opportunities resulting from each action proposed to reduce greenhouse gas emissions?
7. What goals should we aim for and how should we measure success? What are the short, medium and long-term measures that can be taken?
8. Should there be a coordinating body to facilitate actions by the sector?
9. Are there additional factors that should be taken into account?

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5.4 Manufacturing and Processing

5.4.1 Contribution to Greenhouse Gas Emissions

The manufacturing sector accounted for approximately 11.5 per cent and 10 per cent of Nova Scotia's greenhouse gas emissions in 1990 and 1996, respectively. The contribution of coal mining is included in these figures. It was about 6 per cent and 4 per cent in 1990 and 1996, respectively.

The mining stakeholders in the 1992 public consultations on the NS Action Strategy on Global Warming identified the following sources of greenhouse gas emissions: methane released by coal mines, carbon dioxide from the combustion of coal, mining equipment running 24 hours/day, methane released from the storage of coal, top soil being bulldozed away, and forestry layer burned for open pit mining. The resource stakeholders at the same consultations identified the use of refrigerators by the fishing industry as a significant contribution to greenhouse gas emissions.

5.4.2 Success Stories in Reducing Greenhouse Gas Emissions

Eco Efficiency Centre, Burnside Industrial Park

The School for Resource and Environmental Studies, in partnership with Nova Scotia Power Inc., the Halifax Regional Municipality, and Environment Canada, has set up an eco-efficiency center in the Burnside Industrial Park. The objective is to encourage businesses to look at the park as an ecosystem, and to share resources. In the process the center will help businesses reduce waste, save energy and conserve water. The center will also encourage businesses to reduce direct emissions.

Voluntary Challenge and Registry Program (VCR)

Several of the largest and most energy-intensive manufacturing and processing businesses (i.e., Stora Enso, Sydney Steel Corporation, Bowater Mersey Paper Co. Ltd, Nova Scotia Textiles Ltd., Kimberly-Clark) currently operating in Nova Scotia have registered individual action plans and progress reports with the VCR. Other businesses with operations in Nova Scotia (i.e., Imperial Oil Ltd. and Oland Breweries Ltd.) have been registered through their respective corporate head offices located in another province, or, as in the case with Lafarge Canada Inc., registrations have been consolidated in a sectoral report (i.e., Canadian Cement Council).

The Canadian Industry Program for Energy Conservation (CIPEC) 1997/1998 Annual Report states that "despite strongly expanding economy, more effective energy use has enabled CIPEC companies (virtually all registered with the VCR initiative) to essentially stabilize their aggregate energy-based carbon dioxide emissions at 1990 levels."

One of the most impressive VCR progress reports comes from Labatt Breweries Canada, who, since introducing an energy and water management program in 1993, have reduced

their aggregate energy use per unit of production by more than 25 per cent. CIPEC reports that "Canada's brewers are committed to a three per cent per year reduction in energy use, per unit of production through the year 2000."

5.4.3 What Do You Think?

1. Who can contribute to reducing greenhouse gas emissions in the manufacturing and processing sector?

2. What actions can be taken by the manufacturing and processing sector? For example, is there a need for:

- research activities (e.g., on how to improve energy efficiency)?
- encouraging individual or business action (e.g., through tax incentives)?
- government action (e.g., to improve the energy efficiency of its own operations)?
- public awareness or education?
- cooperation among businesses or sectors?
- partnerships between government and the private sector?

3. How can these actions be accomplished and who could be responsible for which activity?

4. What are the possible barriers that need to be removed or incentives that are required to facilitate the action?

5. What are the economic opportunities resulting from each action proposed to reduce greenhouse gas emissions?

6. What goals should we aim for and how should we measure success? What are the short, medium and long-term measures that can be taken?

7. As an example, how could we reconcile the need to reduce greenhouse gas emissions with the opportunity to develop a petro-chemical industry in Nova Scotia?

8. Should there be a coordinating body to facilitate actions by the sector?

9. Are there additional factors that should be taken into account?

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5.5 Agriculture and Food Production

5.5.1 Contribution to Greenhouse Gas Emissions

In 1990, it was estimated that the agricultural sector produced 1,800 tonnes of greenhouse gases. The sector accounted for approximately three per cent of Nova Scotia's greenhouse gas emissions in both 1990 and 1996. They are mostly made up of methane and nitrous oxide, from cattle digestive processes, manure, fertilizers and the burning of agricultural residues. According to Agriculture Canada, greenhouse gas emissions from agricultural soils have decreased for many years through management practices such as reduced tillage and summer fallow. At the same time, research has shown that soils can "sequester" carbon from the atmosphere. It is therefore expected that agricultural soils will soon become sinks for carbon instead of acting as sources of greenhouse carbon-based greenhouse emissions.

5.5.2 Success Stories in Reducing Greenhouse Gas Emissions

General activities that have reduced greenhouse gas emissions by the agricultural sector include no-till seeding, shorter summer fallow, and an increase in the cultivation of forage crops.

Environmental Farm Plan

The NS Department of Agriculture and Marketing has been managing this voluntary program in collaboration with the Nova Scotia Federation of Agriculture. Farmers are encouraged to adopt best practices, including management measures to reduce greenhouse gas emissions.

Crop Residues

The NS Department of Agriculture and Marketing has been promoting mowing instead of burning of crop residues for some crops.

Ethanol from Crops and Residues as Bio-fuel

Ethanol can be produced from starch-rich crops such as corn, but it is also now possible to produce it from crop residues, forages and crop wastes. Fuel from crops has the advantage of not putting carbon that is in long term storage below the earth's surface back into the atmosphere. Rather, it takes carbon out of the atmosphere during its growth and puts it back into the atmosphere when it is used as fuel. Ethanol can be mixed with gasoline in proportions of approximately 10 per cent. Using this alternative fuel can reduce CO_2 emissions by 40 per cent if CO_2 emissions from crop production are taken into account. Canada produces approximately 30 million liters of ethanol from wheat and corn every year, which takes 0.033 Mt of CO_2 out of the atmosphere .

Research Activities

Most efforts to reduce greenhouse gas emissions in the agricultural sector are currently at the research level. The NS Department of Agriculture and Marketing and the NS

Agricultural College are conducting numerous studies. They include investigations in the following areas:

- pork feeding additives to increase conversion efficiency and lead to fewer CH_4 emissions
- manure management systems that could reduce CH_4 emissions (storage, aeration, composting, application, etc.)
- reductions in nitrous oxide emissions (sub-surface drainage systems and nitrogen leaching, timing of nitrogen application, etc.)
- tillage systems that may improve the efficiency of nutrient absorption to reduce nitrous oxide and carbon dioxide emissions
- grazing strategies that may reduce carbon dioxide emissions

Other Actions That Can Make a Difference

Fossil fuels are used by the agricultural sector for machinery, transportation, to heat buildings, to dry harvested crops, to bring fertilizers and other products to farms. For reducing emissions by vehicles, please refer to the other actions mentioned in the discussion on the transportation sector, in Section 5.2.2. For examples of ways to increase the energy efficiency of buildings, refer to the discussion on the buildings sector, in Section 5.3.2.

Various other actions, some of which are still undergoing research, can be taken to reduce greenhouse gas emissions. They relate to the following areas:

- *Soil management*: These actions relate to the rate of decay of organic matter. The slower the rate of decay, the less carbon dioxide emissions are produced. Reducing tillage, for example, reduces the amount of carbon lost from soils. Most farms use less tillage than previous generations did as equipment is now available to plant seeds directly in untilled soils. Reducing tillage also saves fuel, as tillage takes a lot of energy to lift and turn soil (30 to 40 liters of diesel fuel per hectare can be saved). Eliminating the summer fallow will also limit the amount of carbon lost to the atmosphere. As well, planting more perennial crops will help as they have long roots and trap carbon further down in the soil.

- *Soil nutrient management*: Approximately nine per cent of farm production costs come from the use of fertilizers. Making and using fertilizer is very energy demanding (For 1 Kg of nitrogen used, 1 Kg of carbon is released as CO_2). Fertilizer use could be reduced by applying only as much as is needed, and by placing fertilizer more effectively. Manure can be used instead of human-made fertilizers. As well, legumes can use nitrogen from the atmosphere and thus require less fertilizer. Other factors that can reduce greenhouse gas emissions from fertilizers are the timing of nitrogen application, improving soil aeration, adding neutralizing agent like lime to acidic soils, etc.

- *Manure management (storage, N content, application)*: Manure produces methane, most of which is produced during its storage. A reduced storage time will thus minimize methane emissions. Slowing decomposition rate (e.g., by keeping storage tanks cool), providing better aeration (CO_2, which has lower global warming potential, will be produced), or burning methane as a fuel, are all means to reduce the greenhouse effect.

- *Feeding strategies*: Methane is produced by livestock when food passes through their rumen. Emissions can be reduced if passage through the rumen takes place faster. Passage can be faster with more easily digested feeds (grains, legumes, chopped feed, adding edible oils, feeding less proteins).

- *Carbon storage* : Carbon can be found in trees around farmed land, for example as shelterbeds. Carbon may also be stored in construction materials that will not decay, such as fiberboard made from cereal straw, straw bale, flax fibers.

- *Water management*: Proper water management can also help in reducing emissions by the agricultural sector. Efficient irrigation will prevent the loss of nutrients through erosion. Wetland restoration can help in storing nutrients as well.

Many of these measures relate to using resources efficiently. They are, thus, economically profitable as well.

5.5.3 Adaptation

There are many different ways the agricultural sector may be able to and may have to adapt, depending on what changes to our climate take place. Existing dykes may have to be raised in response to seal level rise.

Many of the management measures to reduce greenhouse gas emissions mentioned above involve using water and nutrients more efficiently. Many of these measures would also constitute appropriate adaptation measures. Changes in fallow practices, for example, can help with retaining moisture.

As well, different crops or varieties could be planted. For example, heat or drought resistant crops, or varieties that are resistant to pests or strong winds, could be cultivated. In addition, the choice of crop may have to be adapted to the change in growing season. If the growing season becomes longer, varieties that take longer to mature may be more appropriate. Switching to winter crops instead of spring crops, if feasible, could also help in reducing summer drought. The mix of crops planted could also be altered.

Other management practices that could help in adapting to climate change include the following:

- altering spacing between plants and rows to maximize root extension and absorption of soil water
- inter-cropping to reduce yield variability
- improving irrigation efficiency through methods such as drip-feed irrigation
- timing fertilizer application and varying amounts according to altered precipitation patterns
- timing application of any pest control chemical and varying amounts according to altered pest outbreaks

5.5.4 What Do You Think?

1. Who can contribute to reducing greenhouse gas emissions in the agricultural sector?
2. Will adaptation be an important issue for the sector? What opportunities exist to facilitate adaptation?
3. What actions can be taken by the agricultural sector? For example, is there a need for:
    - research activities (e.g., on how to improve energy efficiency)?
    - encouraging individual or business action (e.g., through tax incentives)?
    - government action (e.g., to improve the energy efficiency of its own operations)?
    - public awareness or education?
    - partnerships between government and the private sector?
4. How can these actions be accomplished and who could be responsible for which activity?
5. What are the possible barriers that need to be removed or incentives that are required to facilitate the action?
6. What are the economic opportunities resulting from each action proposed to reduce greenhouse gas emissions?
7. What goals should we aim for and how should we measure success? What are the short, medium and long-term measures that can be taken?
8. Should there be a coordinating body to facilitate actions by the sector?
9. Are there additional factors that should be taken into account?

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5.6 Forestry and Forest Products

5.6.1 Contribution to Greenhouse Gas Emissions

The forestry and land-use change sectors accounted for approximately 0.17 and 0.08 per cent of Nova Scotia's greenhouse gas emissions in 1990 and 1996, respectively. Emissions from forest product companies are included under manufacturing and transportation.

At the public consultations, organized in 1992, on a NS Global Warming Strategy, the forestry stakeholders identified the following as sources of greenhouse gas emissions from their sector: heavy equipment and transportation, clear cutting and slash burning, burning of sawmill dust, methane from forest products (bark, wood, sawdust piles, etc.), methane and other GHG from landfilling wood waste, and methane from waste piles of bark and other by-products of milling.

Trees absorb carbon dioxide from the atmosphere and are thus referred to as carbon sinks. It has been estimated that Canada's forests store 12 billion tonnes within trees and 80 billion tonnes within their soils. As a result, deforestation increases the level of carbon dioxide in the atmosphere. When they die, are seriously damaged or are used for fuel, trees release the carbon dioxide they had stored.

Failure to reforest following clear cutting was identified as a major contribution to greenhouse gas emissions by the forestry sector at the 1992 forestry stakeholder meeting of the public consultations on the NS Action Strategy on Global Warming.

5.6.2 Success Stories in Reducing Greenhouse Gas Emissions

Voluntary Challenge and Registry Program (VCR)
Several pulp and paper companies have registered in this program. They are Bowater Mersey Paper Company Ltd. based in Liverpool, Kimberly-Clark Nova Scotia Inc. based in New Glasgow, Maritime Paper Products Ltd. in Dartmouth, and Stora Enso, and Magazine Paper of Port Hawkesbury. These companies have committed to reducing their greenhouse gas emissions by becoming more energy-efficient.

Burning Wood Waste
There is a general trend in the manufacturing side of the forestry sector toward burning wood waste instead of fossil fuel as a source of energy.

Research
The Issue Table on Sinks is conducting research to determine the extent to which forests act as overall carbon sinks or sources.

Other Actions that can make a Difference

There are various other potential ways to reduce the impact of the sector on climate change. For example, energy efficiency in pulp and paper mill processes, the development of wood ethanol as a source of energy, afforestation, and reforestation are all means of reducing greenhouse gas emissions. Forest management practices such as reducing levels of harvesting, planting to regenerate forests after harvest, genetic tree improvement, fertilization, pest, disease and fire control can also help in reducing emissions or in storing more carbon.

The emission of greenhouse gases can also be reduced in transportation activities. Please refer to the discussion on the transportation sector for examples of success stories that may be applicable.

5.6.3 Adaptation

Measures that could help the forest sector to adapt to climate change include the following:

- improving the efficiency of the conversion from raw materials to forest products
- changing the product to use new species or size classes, for example by producing particle boards instead of sawn timber
- changing the species or varieties planted or harvested, for example by switching to species or varieties that are more tolerant to changes in temperature or to drought
- investing more resources in fire prevention
- controlling the spread of new pests and diseases
- moving the industry to areas of optimum tree production

5.6.4 What Do You Think?

1. Who can contribute to reducing greenhouse gas emissions in the forestry sector?
2. Will adaptation be an important issue for the sector? What opportunities exist to facilitate adaptation?
3. What actions can be taken by the forestry sector? For example, is there a need for:
    - research activities (e.g., on how to improve energy efficiency)?
    - encouraging individual or business action (e.g., through tax incentives)?
    - government action (e.g., to improve the energy efficiency of its own operations)?
    - public awareness or education?
    - partnerships between government and the private sector?
4. How can these actions be accomplished and who could be responsible for which activity?
5. What are the possible barriers that need to be removed or incentives that are required to facilitate the action?

6.What are the economic opportunities resulting from each action proposed to reduce greenhouse gas emissions?
7.What goals should we aim for and how should we measure success? What are the short, medium and long-term measures that can be taken?
8.Should there be a coordinating body to facilitate actions by the sector?
9.Are there additional factors that should be taken into account?

5.7 Fishery

5.7.1 Contribution to Greenhouse Gas Emissions

The fishing industry is considered to be a very minor contributor to GHG emissions. At the same time, on a per capita basis, Nova Scotians involved in this industry can achieve significant reductions by improving the efficiency of the boats used, and by changing operational procedures.

5.7.2 Adaptation

Assuming that GHG accumulation in the atmosphere will lead to a warmer, drier climate in most regions of Canada, possible impacts on the Atlantic marine fisheries include:

- Decreases in overall sustainable harvests for coastal and ester populations due to decreases in freshwater discharges and consequential declines in ecosystem productivity.
- Widespread changes in sustainable harvests, locations of fishing grounds, and gear efficiencies for many species. This is expected due to complex and unpredictable changes in the ocean current systems that shape offshore marine habitats.

Measures that could help the fisheries sector in adapting to climate change include the following:

- Preparing to harvest other species, or to farm more heat-tolerant species
- Developing new management techniques, equipment and processing infrastructure; for example, increasing fleets that can travel further away to catch species that move northward, and increasing the number of ocean-going processing facilities
- Managing catch levels as depleted species or populations are likely to be more susceptible to climate change
- Developing new species strains for stocking
- Protecting or constructing habitats, for example coastal wetlands, as they often act as nursery grounds
- Removing or minimizing physical barriers to fish migration such as dams
- Constructing new aquaculture facilities to replace those lost through drought or sea level rise
- In response to the threat of sea level rise and more severe storms, ensure that wharves built or renovated are re-enforced and raised.

5.7.3 What do you think?

1. Who can contribute to reducing greenhouse gas emissions in the fishery sector?

2.Will adaptation be an important issue for the sector? What opportunities exist to facilitate adaptation?

3.What actions can be taken by the fishery sector? For example, is there a need for:

- research activities (e.g., on how to improve energy efficiency)?
- encouraging individual or business action (e.g., through tax incentives)?
- government action (e.g., to improve the energy efficiency of its own operations)?
- public awareness or education?
- partnerships between government and the private sector?

4.How can these actions be accomplished and who could be responsible for which activity?

5.What are the possible barriers that need to be removed or incentives that are required to facilitate the action?

6.What are the economic opportunities resulting from each action proposed to reduce greenhouse gas emissions?

7.What goals should we aim for and how should we measure success? What are the short, medium and long-term measures that can be taken?

8.Should there be a coordinating body to facilitate actions by the sector?

9.Are there additional factors that should be taken into account?

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5.8 Further References

The workbook produced for Alberta's Round Table on Climate Change: Turning Strategy into Action includes numerous international and Canadian examples of successful greenhouse gas reduction projects. The workbook is available at the following World Wide Web address: http://www.climatechange.gov.ab.ca.

Other examples of success stories can be found on the web site of the Voluntary Challenge and Registry Program: http://www.vcr-mvr.ca/vcr-006.cfm

6. Conclusion

6.1 Concluding Remarks

This workbook is designed to obtain your views on the development of a Provincial Strategy on Climate Change for Nova Scotia.

We hope that you focussed on principles that would be helpful for the Strategy and that you kept them in mind throughout the sectoral discussions. The questions that were asked of you, to stimulate debate, are summarized as follows (See Section 4.2):

What Do You Think?

1. Should this principle be adopted?
2. Should this principle be discarded?
3. Would you define it differently?
4. Do you have any other comment about this principle?

The sectors that were discussed in this workbook are the following: agriculture and food production, buildings, energy, forestry and forest products, manufacturing and processing, and transportation. We hope that you were able to focus on the sector(s) that interest you.

Space was provided in the section on principles and at the end of each sectoral discussion for you to write your views. You are encouraged to submit these responses to the Climate Change Working Group, Voluntary Planning, Suite 600, 1690 Hollis St., Halifax B3J 3J9, Tel: 902-424-8644, e-mail: Fraserri@gov.ns.ca, and to bring and address them at the workshops in November. We kindly ask you to submit your responses at the latest on Friday, December 3, 1999, so that they can be included in the report and considered in the strategy drafting process. An electronic version of the workbook is available at www.gov.ns.ca/natr.

We hope that you will have found this process helpful and that you will continue to contribute in one way or another to reducing Nova Scotia's greenhouse gas emissions.

6.2 Extra Space for Comments

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7. Appendices

7.1 Glossary

The *atmosphere* is the envelope of air surrounding the Earth. Most weather events are confined to the troposphere, the lower 10-km of the atmosphere.

CFC is the abbreviation for chlorofluorocarbon, a synthetic gas composed of chlorine, fluorine and carbon, used as a refrigerant, aerosol propellant, cleaning solvent, and in the manufacture of plastic foam. As well as causing ozone layer depletion in the stratosphere (a layer of the atmosphere located higher than the troposphere), CFCs are greenhouse gases. Their use is being phased out. Some of their replacements are "ozone-friendly", but are potent greenhouse gases.

Climate is the average weather pattern experienced by a region. It consists of all the elements of weather, including temperature, precipitation, sunshine and wind velocity. The climate of a region is a summary of the past weather events that have occurred at that location. A description of the climate of a particular area would include the averages and extremes of such things as temperature and rainfall amounts taken from weather records. Many factors influence our climate, including latitude, altitude, topography and large bodies of water.

Climate change refers to changes in the climate as a whole, including weather elements such as temperature, precipitation and wind patterns.

An *ecosystem* is an integrated association of living and non-living things functioning within a defined physical location. The term may be applied to a unit as large as the entire ecosphere. More often it is applied to some smaller area.

The *enhanced greenhouse effect* refers to the effect caused by increased amounts of greenhouse gases from human activities. More heat is trapped near the Earth's surface and the natural greenhouse effect is "enhanced".

Fossil fuels include coal, petroleum, and natural gas. They are called "fossil" fuels because they are made of fossilized, carbon-rich plant and animal remains. These remains are buried in layers and compressed over geologic time, slowly being converted to fuel. Fossil fuels can be extracted from the sediment, millions of years after its deposition. Its stored energy can be used as fuel when it is burned.

Global warming refers to an increase in the average global temperature on Earth. The term is now often used to describe the increase in global temperatures caused by human activity since the beginning of the industrial age about 200 years ago.

Greenhouse gases (GHG) are gases that act as a blanket in the atmosphere by trapping heat. They exist in relatively small amounts and most occur naturally in the atmosphere. The main greenhouse gases (GHG) are water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3), and halocarbons, especially chlorofluorocarbons (CFCs). GHGs

produced by human activities in largest amounts are carbon dioxide, methane and nitrous oxide. They constitute approximately 87, eight, and five per cent, respectively, of Canada's greenhouse emissions.

The *greenhouse effect*: is the popular term for the warming function the atmosphere has in the global ecosystem. Greenhouse gases act as the glass in a greenhouse. Heat is retained and warms the Earth to an average global temperature of 15 degrees. Without the greenhouse effect, the average global temperature would be –18 degrees.

Chemicals occupying less than one per cent of the atmosphere produce the natural greenhouse effect. Small changes in the concentration of these gases can consequently have significant effects.

Weather is the state or condition of the atmosphere with respect to heat or cold, wetness or dryness, calm or storm, and clearness or cloudiness for a certain period of time.

7.2 Further References on the Science of Climate Change

7.2.1 Books, Reports, and Journal Articles

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Intergovernmental Panel on Climate Change (IPCC), 1996. *Climate Change 1995 - Impacts, Adaptations and Mitigation of Climate Change: Scientific-Technical Analyses.* New York: Cambridge University Press.

7.2.2 World Wide Web Sites

- Government of Canada: http://www.climatechange.gc.ca/english/html/index.html
  http://199.212.18.79/~ind/English/Climate/default.cfm

- Environment Canada: http://www.ec.gc.ca/envpriorities/climatechange_e.htm
  http://www.doe.ca/climate/index.html
  http://www.ns.doe.ca/udo/deg.html
  http://www.cccma.bc.ec.gc.ca/eng_index.html (Canadian Centre for Climate Modeling and Analysis)
  http://www.cmc.ec.gc.ca/climate/ (Canadian Meteorological Centre, Climate and Water Information)

- Natural Resources Canada: http://climatechange.nrcan.gc.ca/english/html/index.html
- National Climate Change Secretariat: http://www.nccp.ca/html/index.htm
- Voluntary Challenge and Registry Program: http://www.vcr-mvr.ca/vcr-006.cfm
- Canadian Gas Association (CGA): http://www.cga.ca/gashome.htm
- Canadian Association of Petroleum Producers (CAPP): http://www.capp.ca/
- Canadian Petroleum Producers Institute (CPPI): http://www.cppi.ca/
- Alberta's Strategy on Climate Change: http://www.climatechange.gov.ab.ca
- David Suzuki Foundation: http://www.davidsuzuki.org
- The Pembina Institute: http://www.pembina.org
- USEPA Global Warming site: http://www.epa.gov/globalwarming/
- United Nations Framework Convention on Climate Change: http://www.unfccc.de
- United Nations Environment Program: http://www.unep.ch
- World Meteorological Organization: http://www.wmo.ch
- Intergovernmental Panel on Climate Change: http://www.ipcc.ch/
- World Wide Fund for Nature: http://www.panda.org/climate/climate.htm

7.3 Policy Options

There are many different actions that can be taken to address climate change and reduce our GHG emissions. More fuel-efficient cars are available now, and within a few years, vehicles should be available that use less than half the fuel of most vehicles currently on the road. With all the potential measures identified here in this workbook, or at the consultations, it is important to keep in mind that there are many different ways to reduce our emissions. It is for us, as a province, to decide the most effective way to achieve emission reductions and to what degree we wish to reduce emissions.

Perhaps the most important factor in deciding which measures to adopt and which policies to implement is the support they will get from Nova Scotia residents and businesses. In order for us to face the challenge of climate change effectively, Nova Scotians will have to become champions to help us reduce the rate of climate change. This process, therefore, challenges all of us to work together to reduce emissions, whether on behalf of the youth, seniors, industry or government.

Some questions need to be asked including who benefits economically from these various measures, who bears the burden, and how will a proposed measure affect the overall well-being of Nova Scotians? Many technologies are available to reduce emissions and others are being developed. Technologies developed outside Nova Scotia will create economic activity in other jurisdictions. Some provinces, for example, have proposed importing electricity from large-scale hydro projects to Nova Scotia to help us eliminate the need to burn fossil fuel to generate power.

Another example of the complexity of the issue is presented by the Sable Offshore Energy Project. The gas from the project will allow the end user to reduce emissions by switching from coal or oil to natural gas. At the same time, Nova Scotia's emissions will increase due to flaring, leakage and other releases related to the production, processing, transmission and distribution of natural gas. A petrochemical industry based on our natural gas resources will further increase Nova Scotia's emissions. How do we evaluate the economic benefit of proceeding with these developments against the cost of increasing GHG emissions?

It is also important to consider our relationship with other jurisdictions. The United States, for example, has the lowest energy price of any developed country in the world. Actions that will result in higher energy prices in Nova Scotia, may put us at a competitive disadvantage with respect to the United States, unless they take similar measures. There is concern, for example, that a carbon tax in Canada without a corresponding tax in the US could adversely affect the competitive position of Nova Scotia industries that are energy-intensive. Before proceeding with policies to reduce emissions, we need to determine who would be affected adversely, and how we could ensure that no one bears an unreasonable burden.

In some cases, costs resulting from GHG emission reductions may be offset through increased energy efficiency, but other measures may also be required. To ensure equity, the cost of these additional measures may have to be incorporated into any discussion on the ability of these measures to achieve GHG emission reductions. There are also actions generally called "no

regrets" actions that are considered to be of economic benefit on their own and improve our ability to compete. These actions have short and long term economic benefits, as well as social and environmental benefits.

7.3.1 Examples of Policy Options

The following are some policy options for Nova Scotia. They are listed here to stimulate discussion for the sector by sector analysis only:

1. Regulations

The traditional form of government intervention to achieve a policy objective has been to regulate. In the context of climate change regulations could range from requiring car manufacturers to meet certain emission standards, to requiring new homes to meet certain energy efficiency requirements. Regulations can also complement other options, such as regulations to help implement an economic instrument to discourage use of fossil fuels.

2. Ecological Tax Reform

This policy option would involve a comprehensive review of how provincial revenues are raised and spent to determine where the current system provides incentives to burn fossil fuels that may affect individual or business decisions. The review would also identify ways that revenues are raised or spent that discourages conservation or the use of renewable energy. Tax reform would eliminate disincentives and/or provide incentives for individuals or businesses to take actions that reduce emissions. It would also remove incentives and/or provide disincentives for actions that result in emissions.

A carbon tax is one disincentive that has been discussed and is used in other parts of the world. It would involve adding a tax to the price of any fossil fuel to either raise money for reductions elsewhere, or to discourage Nova Scotians from buying oil or gas. The carbon tax would raise the cost of fuel by building the environmental cost into the price or oil and gas. Carbon tax systems can either be revenue neutral, which means there are implemented in conjunction with tax breaks in other areas (such as a reduction in income tax), or the revenues can be set aside for specific action to reduce emissions in other areas. For example, the money could be used to subsidize energy efficiency or green energy options.

3. Cap and Trade

A maximum emissions target is adopted and individual emitters are allocated a portion of the emissions based on their historic emissions or by some other formula. Emitters covered by the system are required by regulation to hold allowances equal to the carbon

content of their products. Sources of other GHG emissions are also required to hold allowances equal to their actual emissions. A limited number of allowances, consistent with our reduction target, are made available. Participants with excess allowances can sell them to participants that do not have enough. Emission reduction credits created by sources outside the jurisdiction covered by the cap may also be used to meet regulatory requirements. This would allow an emitter to either reduce emissions to the allowances allocated to it or purchase additional allowances either within the capped jurisdiction or elsewhere from emitters who have reduced emissions more than they had to.

A cap and trade system would have an effect similar to the carbon tax, except that depending on how the system is implemented, only certain sectors of society could be affected. The allocation of allowances would either be by auction, or they would be allocated based on past emissions. Cap and trade programs can be implemented at the production level, at the retail level, or anywhere in between, depending on who should bear the cost of reducing emissions.

4. Focus on Public Education and Individual Responsibility

Well over one-half of the emissions in Nova Scotia are under the direct control of individuals. If properly motivated, significant reductions can be achieved through voluntary individual action in the home, with respect to transportation, and by reducing consumption. Education and other initiatives focussing on individual responsibility can be an important component of any strategy.

5. Green Energy Procurement

The province could commit to having a percentage of its total energy needs met from new "green" power sources. This commitment could represent the first step in an enhanced green power procurement strategy that could see more aggressive procurement targets adopted in future years. To meet the initial commitment, the government could set aside funds to support this initiative. These funds would be made available to cover any incremental costs incurred by substituting new "green" energy for energy currently obtained from existing conventional energy sources.

The government could increase its efforts to procure energy efficiency by making a commitment to undertake energy efficiency retrofits in government buildings, for example.

6. Energy Efficiency Policies

There are a number of policies available to achieve better energy efficiency in commercial buildings, in homes, and within various industries. The following is a sample of policies that have been considered in other jurisdictions.

The government could allocate funds to an efficiency retrofit fund. This fund would encourage and support the investment in energy and water efficiency in commercial and institutional buildings and operations by providing loans and loan guarantees.

District energy systems can be used to efficiently deliver energy services to multiple buildings in close proximity. The provincial government could help municipalities and local developers overcome some of the financial and institutional barriers currently hindering development.

The province could support a Green Communities Program for Nova Scotia either directly, or in cooperation with corporate partnerships. This program could set a goal of delivering an environmental inspection to every home and small business in Nova Scotia over the next 10 years. This option could create jobs and lead to investments in energy-efficiency and environmental sustainability.

7. Alternative Transportation Policies

The government could direct funds to support the development of sustainable transportation alternatives through the provision of matching grants. The fund could provide grants to municipalities and regional transportation authorities investing in sustainable transportation infrastructure.

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Allowable infrastructure could include programs to reduce transportation demand, such as:

1) Transit fleet expansion, replacement and modernization.
2) Light rail construction, upgrading, expansion and modernization of rolling stock.
3) Dedication of existing road space to transit and high occupancy vehicles.
4) Transit priority measures.
5) Transportation demand management programs (e.g. workplace and institutional trip- reduction programs that facilitate and encourage carpooling, van pooling and transit usage).
6) Cycling and walking infrastructure primarily aimed at increasing commuting by walking and biking.
7) Improved inter-modal connectivity (e.g. bike racks on buses; services to airport and ferries).
8) Transit infrastructure improvements such as advanced technology fare collection and customer information systems, bus shelters.